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HOW OUR NAVY BUILDS BASES-P. 90



When you see those new cars with Body by Fisher-you'll be quick to say that beauty takes a bow. They are truly beautiful.

It's easy to see that the Fisher Body organization has come out of the war with its skill and craftsmanship at a new peak.

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Strategic Middle Route, uniting California with the mid-West and the East.

The necessities of war brought new glory to California as an industrial area. Its natural resources and healthful living conditions will stimulate peacetime industrial expansion; will attract thousands of "prospectors" seeking golden opportunity in postwar enterprises. California will continue to play a leading role in bringing greater prosperity to your America.

NOTE: Write Union Pacific, Omaba, Neb., for information regarding industrial or business sites in California or other western states.



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YOL 147 NO. 5

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

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VINCENT J. BURNELLI (page 65)
has worked for 25 years designing airplanes whose fuselages would exert
lifting power in addition to that of the
wings. The present eighth Burnelli
plane has had successful flight tests
and promises speed, economy, and
safety in the transport field.

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COMING SOON: A SYNTHETIC TIRE THAT WILL OUTWEAR PREWAR TIRES

This isn't a guess. A new kind of tire has been developed, and tests show that it will outwear prewar passenger car tires.

It is made of a new kind of synthetic rubber developed by B. F. Goodrich—different from the ordinary synthetic rubber in general use by the tire industry.

The new tire has had more than 2,000 separate tests. Taxicab fleets, state police departments and the B. F. Goodrich test fleet have run it 16,800,000 test miles. Not only does it give longer tread wear than prewar tires, but it has more resistance to bruising or damage

from accident.

A new, slightly different shaped tread—we call it the "road level" tread—is another feature that means longer wear. Engineers had wished for years to make a tread just alightly flatter. But that more desirable shape always set up strains in the tire body, or "carcass," as it is called. B. F. Goodrich developed an entirely new and stronger cotton cord, designed it into a carcass that stands all these strains and permits the use of the new flatter, longer-weating tread.

In a few weeks these new tires will begin to be produced in large volume for shipment to our deal ers, but supplies may be limited for quite a while. So take good care of the tires you have—make them last until you can replace them with these new, better B. F. Goodrich Silvertowns. The B. F. Goodrich Company, Akron, Ohio.



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TINY GIANT WITH A HISTORY

Long before the war, the men who design your Bell Telephone System were looking for an electron tube with frequency capabilities never before attained. With it, they could transmit wide bands of telephone messages—hundreds of them simultaneously through coaxial cable—economically, and over long distances.

They developed a tube which set a new standard in broad-band, high-frequency amplification. So minute that its electrode system had to be inspected under a magnifying glass, the tube could amplify either the voices of 480 people talking at the same time, or the patterns of television. Long-distance, broad-band transmission became a commercial reality.



When war came, this tube excelled all others as an amplifier in certain military equipment. It then grew into the 6AK5, one of the great little tubes of the war. Besides producing 6AK5's in large quantities, the Western Electric responded to emergency needs of the Army and Navy by furnishing design specifications and production techniques to other manufacturers, of whom at least five reached quantity production. On every battlefront it helped our ships and planes to bring in radio signals.

Developing electron tubes of revolutionary design has been the steady job of Bell Laboratories scientists ever since they devised the first practical telephone amplifier over thirty years ago. Now tubes like the 6AK5 will help speed the living pictures of television, as well as hundreds of telephone conversations simultaneously over coaxial highways of the Bell System.

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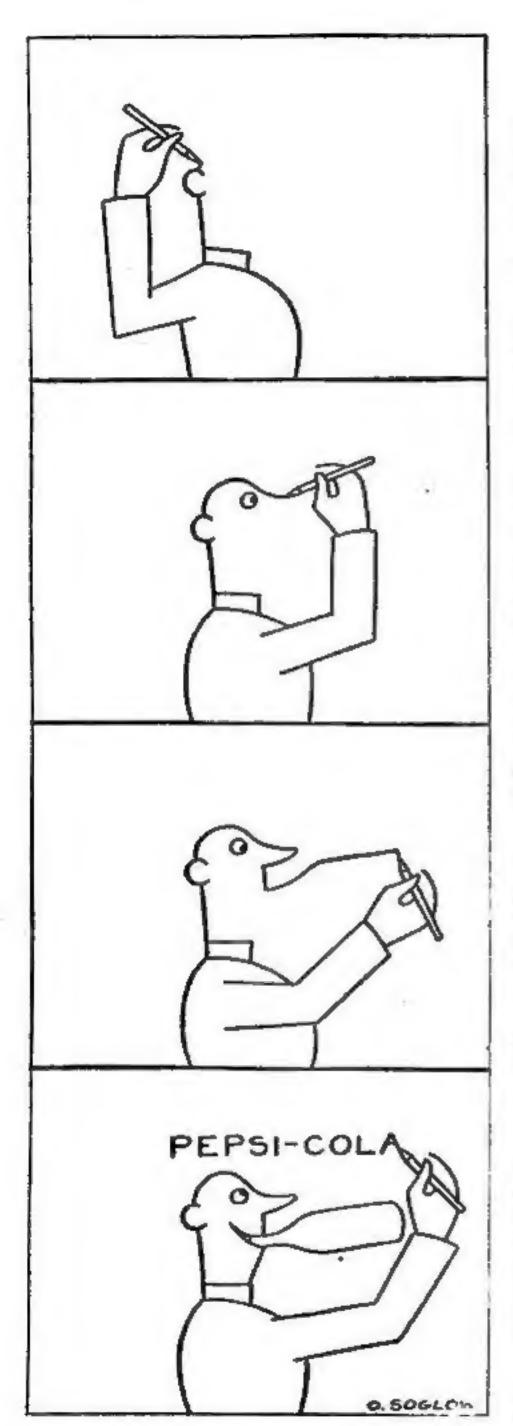
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TREMENDOUS WEALTH IN NATURAL GAS. It used to be regarded as a convenient means of heating and illumination for those fortunate enough to live where it was available. Natural gas now promises to be the basis for a new industry. Read of the wonders it produces, including, maybe, nine-cent gasoline.

HOW TO TAKE HOLLYWOOD COLOR PIX. An ace photographer of the film capital gives the low-down, and what he says is backed up by eye-dazzling color pictures. The story covers indoor and outdoor lighting, make-up for portraits, and color selection.

NEW YORK'S NEW MAMMOTH AIR-PORT. Dwarfing all other metropolitan airports in size, completeness, and cost, Idlewild Airport, wrested from the swamplands of Jamaica Bay, shows the Big City's belief in the future of air travel. Here are the thrilling details of the daring project.

SYNTHETIC CRYSTALS, made out of chemicals for wartime use, are now being proved valuable in peacetime industry, and the field has only begun to be explored. This article outlines the development of the processes for making these valuable optical aids.

TEST RADIOACTIVITY YOURSELF. Take a harmless look-see into this storehouse of atomic power with the aid of the homemade detection apparatus described in this story. It will help you to keep abreast of developments at the beginning of the Atomic Age.

SERVICEMEN ATTENTION!

In the December issue, POPULAR SCI-ENCE MONTHLY will announce a \$3,300 craftwork contest for servicemen, service women, and veterans. Special service and handicraft officers with units overseas can get a head start by writing NOW for a supply of posters announcing the rules, awards, and other details. Address POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N. Y.

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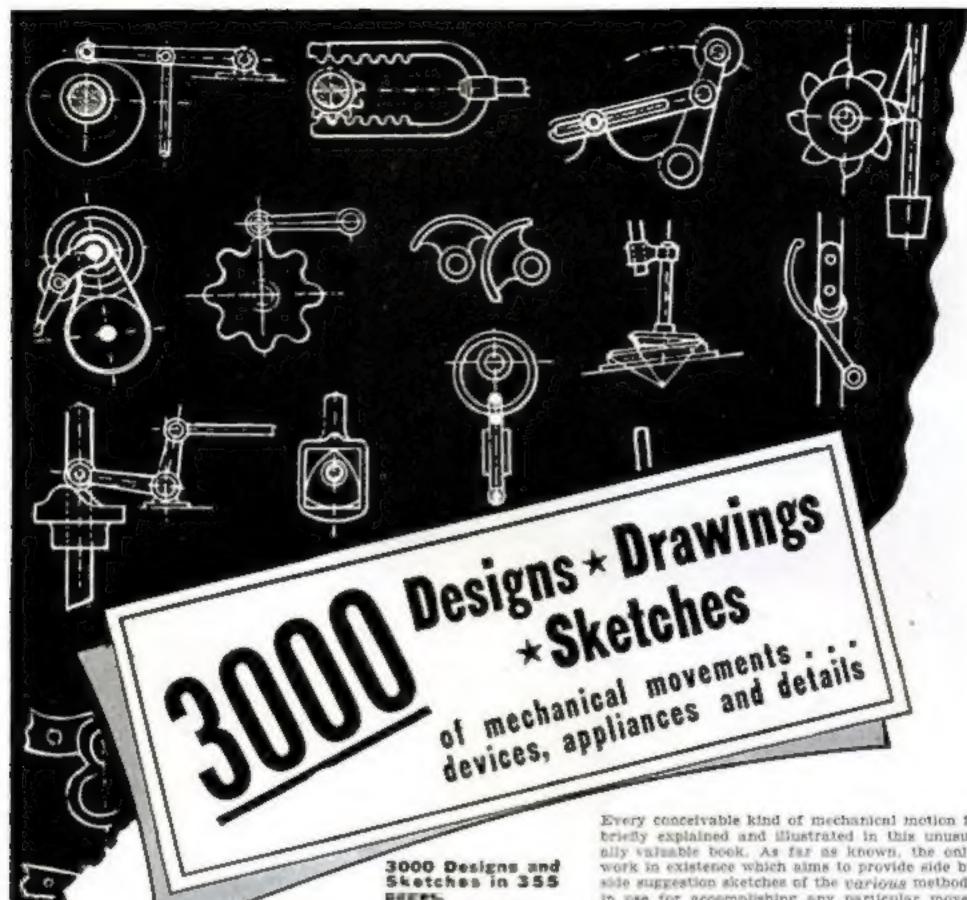
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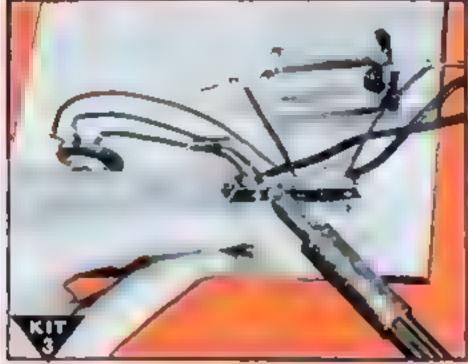
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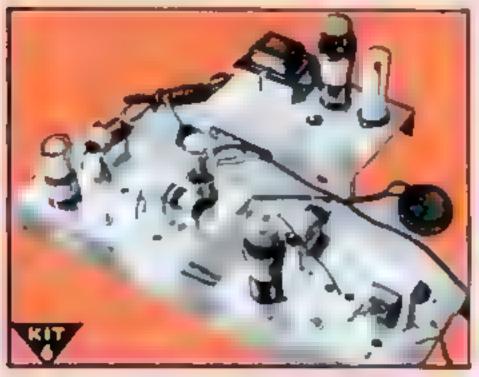


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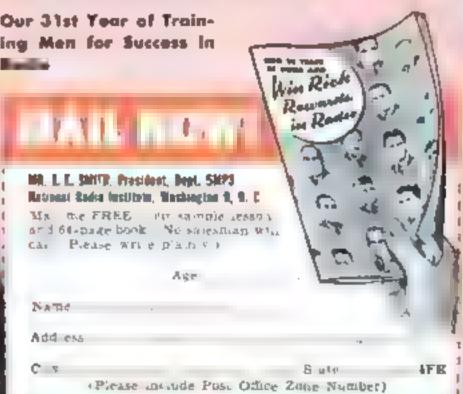
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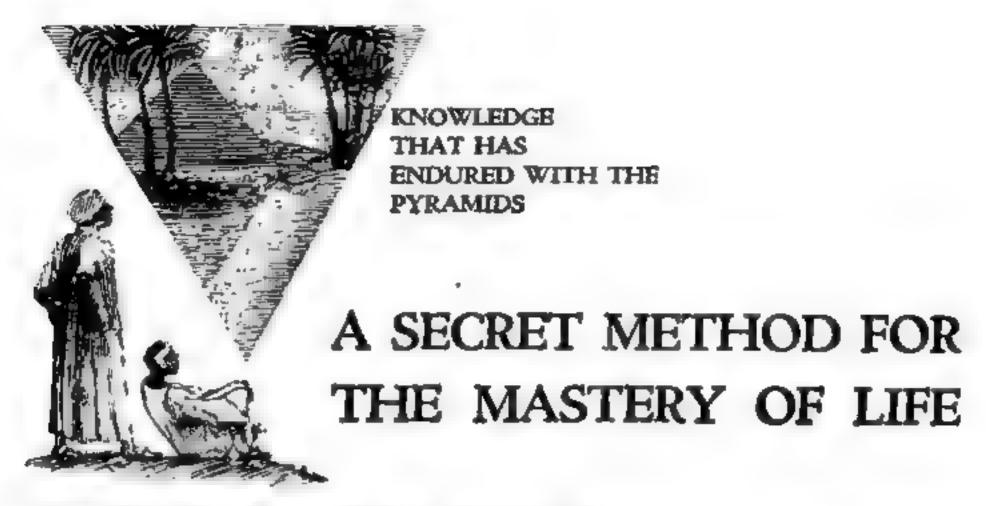
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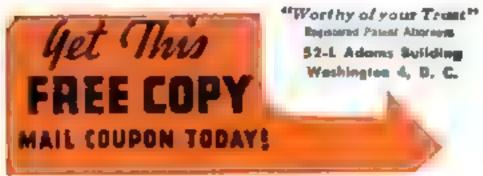
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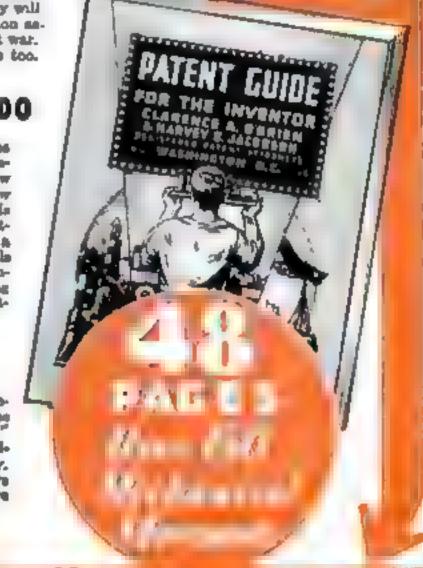
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Army Officer Champions Lighter-than-Air Craft

The article, "Airships for the Coming Air Age," by Hal Borland, in the May issue of P S. M. was particularly interesting to me. I became very much interested in lighterthan-air craft in 1929, when I was a member of the Lighter than Air section of the Naval Aircraft Factory. Even before the Hindenhurg accident, I was of the opinion that the poorly informed heavier-than-air industry, backed by prejudiced airplane pilots, were deliberately fighting the dirigible as a dangerous competitor in transoceanic travel. They apparently could not be made to realize that the airship and the steamship would serve a different clientele, desiring greater luxury than planes could afford and requiring less speed. It is my belief that the lack of dirigible plane carriers handicapped our Pacific war effort, and that it was a direct result of antilighter-than-air propaganda.

I was disappointed that your article neglected to mention the only truly American lighter-than-air basic design, the Detroit Aircraft's metal-clad, pressure-rigid ZMC-2, which was successfully operated by the Navy for about 10 years and then broken up for test. After this time, tests showed practically no deterioration of its paper-thin, aluminum-clad, aluminum-alloy skin. Its design and manufacture were most ingenious, and it differed in principle from the Zeppelin types.—Lt. Col. L. C. R., APO, San Francisco,

Calif.

You'd Better Carry a Broom Straw During the Watermelon Season

HERE is one that has got me puzzled. Place a broom straw horizontally across a watermelon. If the melon is ripe, the straw will turn to a 45-degree angle; if it is green, it will not move. Some of the amart readers of P. S. M. maybe can tell us where the push or pull on the

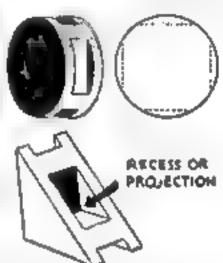


broom straw comes from when the melon is ripe.—E. J., Dickinson, Tex.

Metal-Casting Problem Is Solved Two Ways

HERE'S my solution to E. B.'s problem in the July P. S. M. I think the front of the casting, of which the end and top were shown, is a circular piece with horizontal cuts at the sides. This would produce the squares and grooves shown on the front and

given. I have read P. S. M. enthusiastically for five years and enjoy it more than any other magazine. I am 16 years old and have just finished two semesters of high school.—R. L. Oshkosh, Wis.



Enclosed is what I believe to be the answer to E.B.'s question. I have made an isometric of the casting. The hole in the center of the casting can also be a projection of the same dimensions, since the top and side views do not confirm either.—G. P., Brooklyn, N. Y.

Moral Code for Scientists Seen as Antiwar Measure

The recent letter by L.S., of New York City, is very timely, since it deals with one of the greatest problems facing the scientific world today. As a former instructor of physics, I think that I can safely say that in recent years scientists have strayed away from the true philosophy of science. This is partly due to the high degree of specialization resulting from increased technical knowledge and partly to the failure of the scientists to establish a scientific moral code. True scientists do not need the stimulus of war to excite the curiosity that results in rapid progress.

There is nothing vitally wrong with science, for science is a philosophy, a method of obtaining information by rigorous mathematical reasoning. It is the scientist who is to blame, partly due to the reason given above; also because he allows the tinge of nationalism to creep into a profession that is universal and that must of necessity reject any right established by the use of might. When scientists reject these inconsistencies, they will be ready to sit in an international organization for the abolishment of war. Meanwhile, as wars become "bigger and better," the scientist must assume more and more responsibility for the destruction of humanity,—Pvt. J. T. P., AAF, Lowry Field, Colo.



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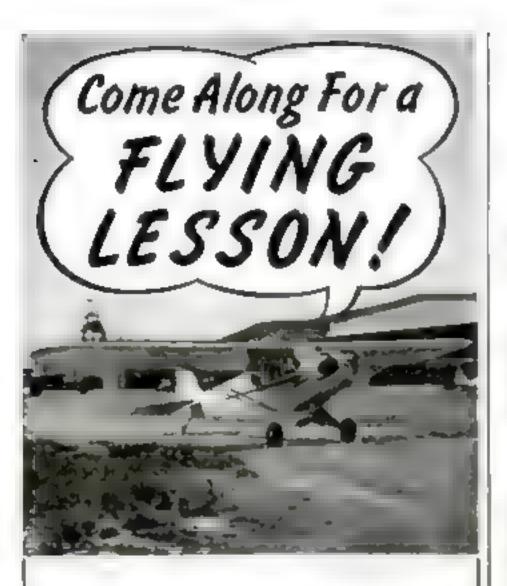
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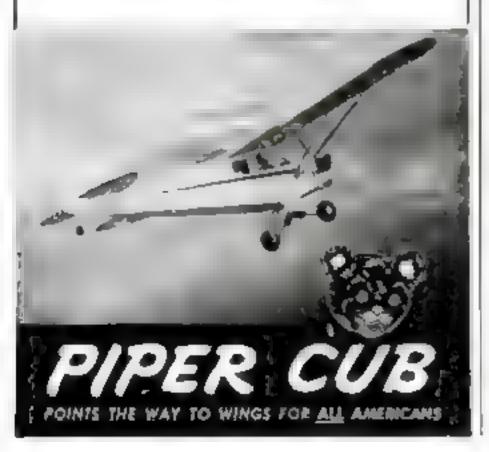
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Bottle Cutting Calls to Mind Boyhood Stunts of Early 1900's

There seem to be several ways of cutting bottles to make tumblers, but the method we used in 1900 was perhaps the simplest. Just dip a yarn string in keresene, wrap it around the bottle at the point chosen, apply a lighted match, revolve bottle slowly so it will heat evenly, and then sprinkle it with

water

Back in those days I was able to float a needle on water without the help of toothpick, cardboard, or oil. I just laid her gently on the water, and there she was! A gadget my cousin and I made, which I have not seen since, might also be of interest to the present generation. We took a tomato can with one good end in it and punched a hole in this end with a hail. Then we tossed a lump of carbide on the wet ground, placed the open end of the can over the carbide, and held lighted paper over the nail hole. Bang! Gas rocket.—G. C. K., Cape Charles, Va.

With the recollection of a singed hand re-

aulting from an experiment with a piece of carbide, a saucer of water, and a lighted match, we sarnestly recommend that research with this form of gas rocket be accompanied with the utmost discretion. The flame held over the nail hole ought to be on a long pole.—Ed.



Why Doesn't Somebody Suggest Stuffing Dolls with It?

H.B., or Port Arthur, Canada (August issue), might use his sawdust in place of sand for mixing with Portland cement and casting building blocks, floor blocks, and the like. It would be lightweight, unexpectedly strong, insulating, fire-resistant, and inexpensive. The trick is to use just the right amount of water for the mixture. H.B. would have to make tests to get the right proportions for what he wished to make.

When properly mixed with soil and then rotted, sawdust makes a partial fertilizer. Also, when briquetted with a minimum of asphalt or tar, it makes a hot, long-burning fuel.-W. A. B., Fort Lauderdale, Fla.

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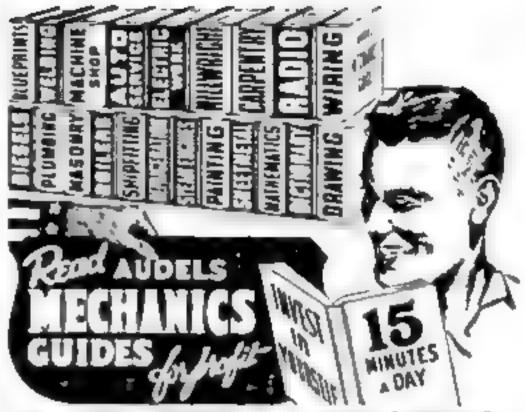
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Can someone tell me how to remagnetize a magnetic tack hammer?—E. M. C., Wau-chula, Fla.

Housewife Drops Chores When P.S.M. Shows Up

On the day your magazine arrives, I do very little housework. I read it from cover to cover, and then wish the next issue would come sooner. I start with the story about

Gus, whom I have come to regard as a very real person and friend. I enjoy the articles on photography, household hints, uses for salt, soap, etc. Now, Sir, how about a woman's department? Most women's magazines are written for women with "time on their hands"—or for those who do not



have to stretch pennies to make ends meet. May I suggest a few articles that would interest women who, like me, live on small farms? (1) How to wash, bleach, and use muslin grain bags. I wish I knew how to bleach them without ruining them. I know hundreds of uses. (2) How to make lineleum blocks, and how to print with waterproof paint. (3) How to pluck a chicken. How to clean and prepare for marketing. (4) How to refinish furniture—such as bureaus, tables. etc., using varnish remover, sandpaper, wood filler, stains, and varnishes, (5) How to make attractive one-dish meals. (6) How to live alone and enjoy it: planning a comfortable one-room and kitchenette spartment.—(Mrs.) M. W. S., Medway, Mass.

Some of these subjects have already been treated at length in P.S.M., but we're doubtful about that living alone and really enjoying it.—Ed.

He Wants to Know How to Breed Turtles

I wonpen if any of your readers could send me information on the care and breeding of turtles.—R. P. C., Toronto, Canada.



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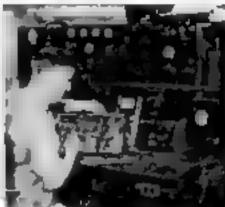




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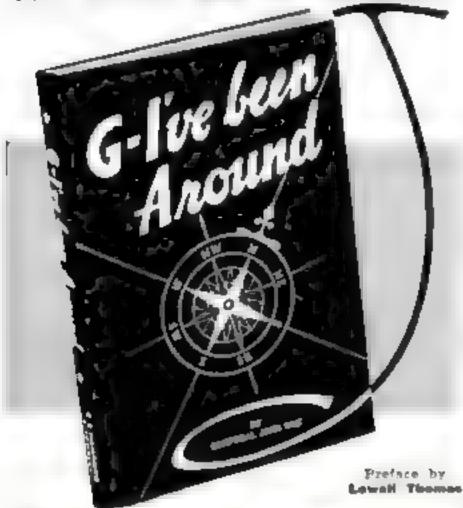
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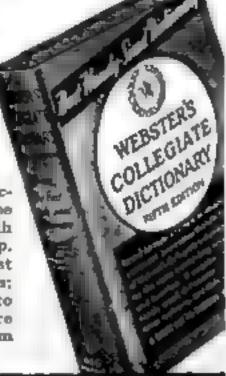
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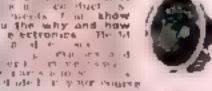
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By S. T. CHRISTENSEN

the "Fix-it Man"

"WELL, I guess I'm the fellow to see, for VI've repaired thousands of refrigerators (home and commercial both), vacuum cleaners. radios, washing machines, irons, fans, lamps, mangles, motors, etc. In fact, many of my customers call me their "electrical appliance doctor." And, "doctoring," I might add has paid me a good substantial income for quite a few years. Funny, in a way, how I got started. Always liked to tinker and by experimenting around I found that most electrical appliances had many things in common. That, regardless of what the appliance was used for, or who the manufacturer was, the basic principles were much the same. From fixing my own appliances to fixing friends' and then for strangers at a fee, seems now to have been but a small step.

What to Churge?

At first, I let the owner decide the charge and, frankly, I was amazed at what I carned per hour. But then, when one figures what initial costs are involved in buying most electrical appliances, one can readily see that spending extra dollars for repairs is well worth while. Before long I was making more in my spare time repairing than from my regular job. The result . . . I went into business for myself. When war came, business boomed, for new appliances were not available.

For a while, repair parts (needed on some jobs) were a little difficult to get. But that

aituation seems to have adjusted itself for many repair parts have today the high priority rating of AA2. After all, we must provide for the health and well-being of our civilian population.

The Future Offers

Friends ask me about my future. And, I think I've got a grand one. Age is no handicap in repairing. I have in my files enthusiastic letters from repairmen ranging in age from 18 to 79 years. After the war, we're bound to see hundreds of new products on the market . . . products that the average person never dreamt of. These new products and our old appliances are all going to need at some time or other "fixing." Well, I'll still be the fellow to do it. The field open for appliance repairmen is unlimited. I don't worry at all about too much competition

If You Are Ambitious

To the contrary, I've prepared a complete course, chuck full of simple, easy to understand photos and drawings and written in the same non-technical language as this article. I know the course is good, because I have hundreds of men all over the country writing to me telling me how the course has helped swell their pockets with cash. If you too want to prepare now for your future, I suggest you read the next page and send me the handy coupon."



PREPARE NOW FOR THE FUTURE

If now in war work, start your home appliance repair business NOW in your spare time and be set with a business of your own when the war is over. You don't need elaborate fixtures or expensive equipment to be a successful repairman. Operate from your garage basement, vacant more, etc. Work as many hours as you wish-the home appulance repairing is his own boss. It is a profitable occupation for on many types of repairs it is not unusual for a repairman to charge on the basts of \$5 00 to \$8.00 per hour. Don't gamble with your future-learn a trade that will always support you. Remember, as long as electrical appliances are used, there will be a need for electrical appliance repairmen.

If you are at all mechanically inclined-can hold and use tools-then you have all of the qualifications required for becoming a big money sarning home appliance repairman. It does not matter if you have not had a great deal of schooling or had previous experience along these lines-WE WILL TEACH YOU. Age should be no barrier-nor should any minor physical handlesp.

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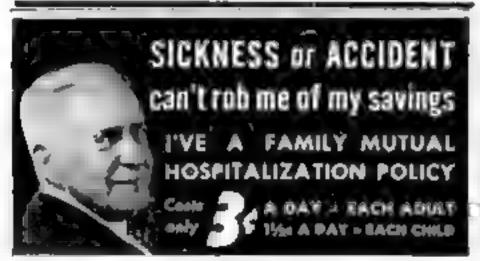
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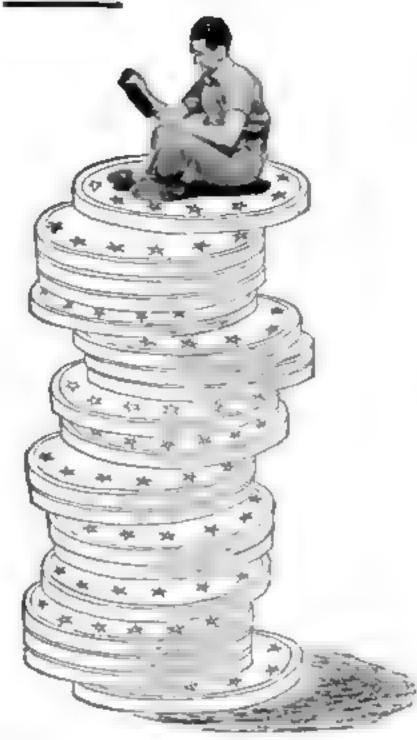
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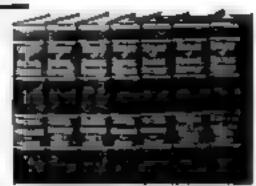


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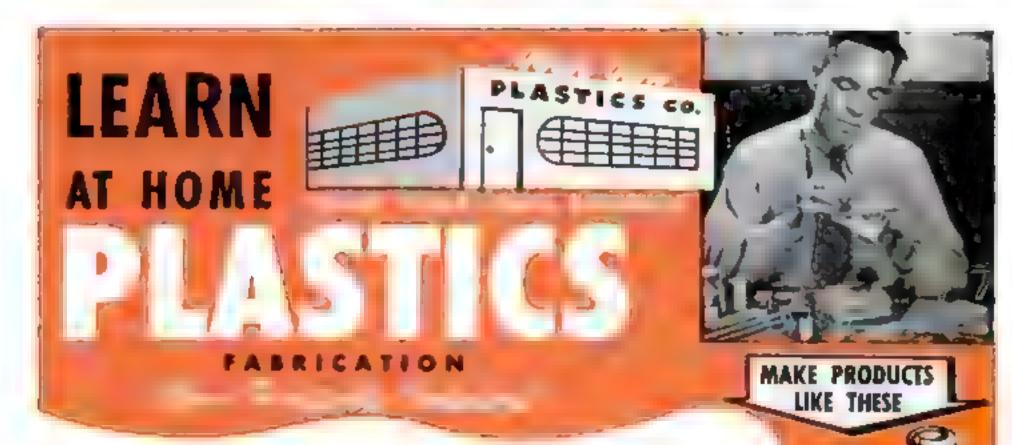
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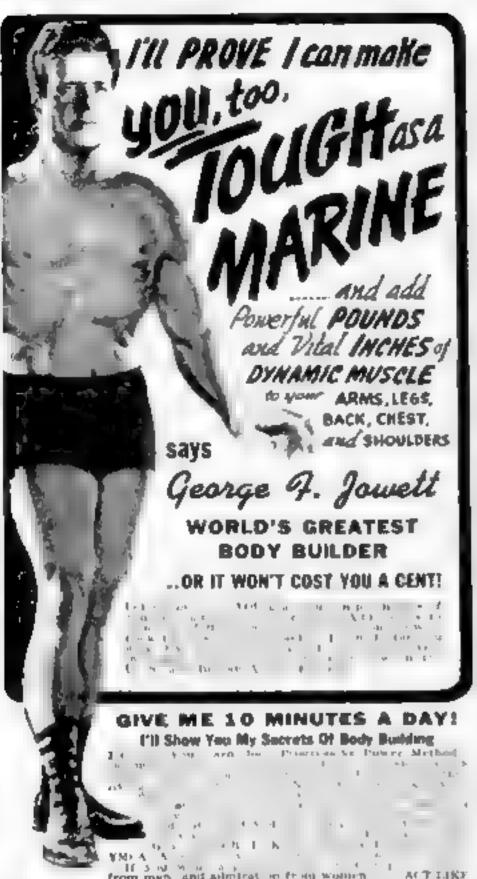
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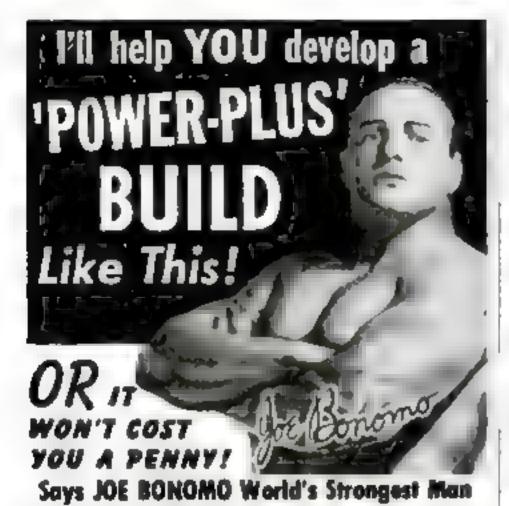
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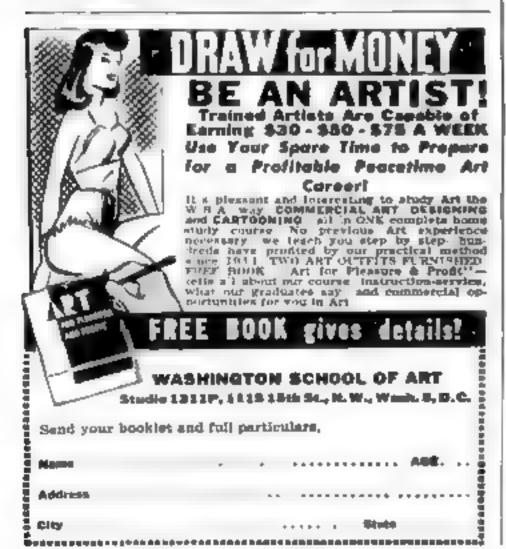
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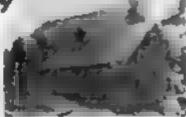
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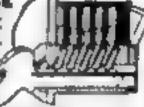
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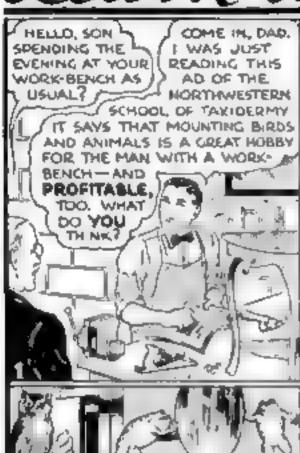
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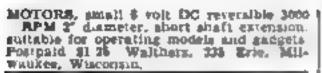
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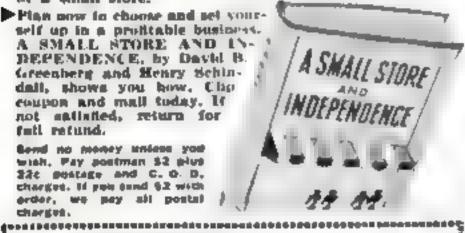
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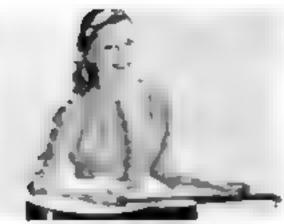
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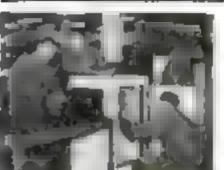
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IHPORTANT,

To All Who Hope to Fly Their Own Personal Planes by Spring, 1946

WE at Taylorcraft believe in action, not words. The facts are these. We are delivering Taylorcraft planes in volume—and have been since V-J Day.

But so great has been the advance demand for side-by-side airplanes at moderate cost that even though Tayloreraft—world's largest builders of side-by-side airplanes—is now in production at a rate unprecedented in all peacetime aviation, still demand exceeds supply.

To insure fairness in distribution, priorities are being established on a "first come—first served" basis. This applies not only to orders but to requests for information.

To make sure of getting your Taylorcraft at the earliest possible moment, we respectfully suggest that you send now for the name of your nearest Taylorcraft dealer—and that you fly this amazingly safe and comfortable plane without delay.

Prompt action now will guarantee you against having to take "second choice"—if you want to fly by Spring!

Mach Russ

VICTORS! Because you weren't here to order your personal plane, we at Taylorcraft have reserved 25% of our entire pro-

duction for you. Just show your discharge papers-and go to the head of the line!



World's Largart Bullions of Two and John Passanger Side-by-Side Anglangs

Write: TAYLORCRAFT AVIATION, Dept. S. Alliance, Ohio (Division of Detroit Air-Craft Products, Inc.)

TAYLORCRAFT Model B-12 (Two Place, Side-By-Side All Purpose Plane)



Climb (first minute) 600 feet Service ceiling 11,800 feet Cruising range 378 miles Fuel consumption.... 23 m.p.g. Landing speed 40 m.p.h.

Price: \$2295
Fly Away Alliance, Ohio

We will finance your plane for only \$763 down, balance divided in twelve monthly payments.

TAYLORCRAFT IS TAKING ORDERS AND DELIVERING PLANES TODAY A

NOV. 1945 POPULAR SCIENCE MONTHLY

The new CBY, a modified flying wing, designed by Vincent J. Burnelli, gets approximately 40 percent of its lift from the fuselage center section. Its radical styling enables it to carry big payloads at low cost.

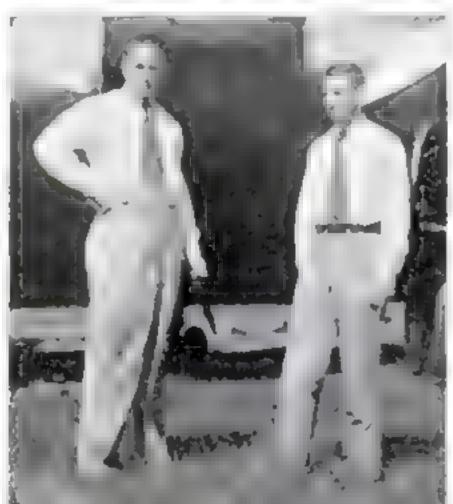
PUTTING PLANE'S FUSELAGE TO WORK

By DEVON FRANCIS

Photographs by WILLIAM W. MORRIS

UST a quarter of a century ago a young Texan, fiddling with a drafting pencil, aketched out an idea for aircraft architecture that today threatens to work a revo-

Veteran test pilot Clyde Pangborn (left) says the CBY is the most efficient transport ever built.



lution in the design of the world's transport airplanes. The man was Vincent Justin Burnelli, and his idea was to make an airplane's dead weight do some work.

He devised a way to make the fuselage an integral part of the lifting atructure.

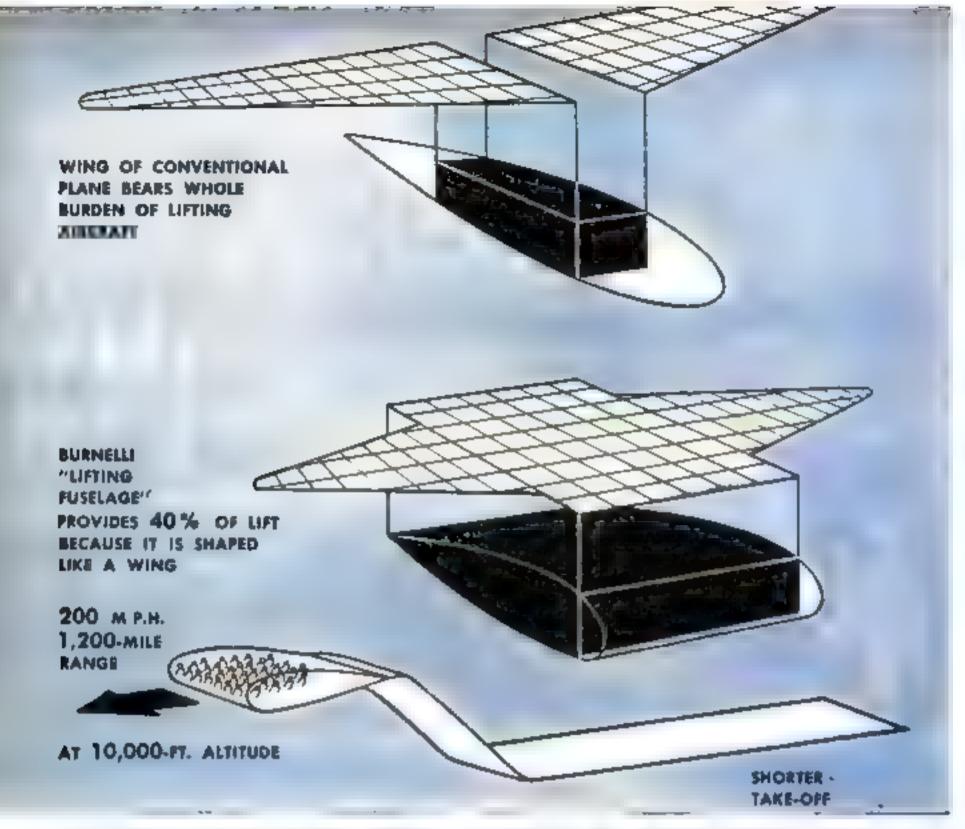
Twenty-five years bewed out of a man's life is a long time. It has taken patience for Burnelli to get his idea across. But now the eighth in a list of Burnelli planes having fuselages shaped like wings has undergone successful flight tests. It is not a "flying wing." It is a modified flying wing. Burnelli is convinced that a pure flying wing is a dream that probably never will be fulfilled.

The test flights on the new plane, called the CBY, have proved just what Burnelli said they would prove. Compared with the standard twin-engine transport plane used generally by the commercial air lines, the Burnelli plane:

Weighs a ton less, or only 14,500 pounds, when empty. This saving is translated into payload.

Weighs a ton more, or 27,000 pounds, fully loaded. This, too, is translated into payload.

Flies 25 miles an hour faster, or at 200 miles an hour. This makes for economy of



The Burnelli design appases working weight to a conventional plane's dead weight. Eighty-six percent of the surface of the CBY "works," as against only 50 percent on the average transport. The cylindrical fuselage is dead weight, says Burnelli, and the bigger it gets, the greater is its skin friction—resistance to the air flowing over an airplane's surface. The CBY's lifting fuselage puts the skin to work.



Compared with the standard air-line transport, the CBY contains 2,500 cubic feet of space as against 1,700, and 360 square feet of floor space as against 182. It weighs only 14,500 pounds empty and 27,000 loaded, and needs only two 1,250-hp. engines.

The CBY's boslike fuselage afters greater safety. The passenger and pilots' compartments are surrounded by 65 percent of the plane's structural weight; the fuselage of a conventional transport has a strength of about 15 percent of the whole.

The new plane has a wing span of only 86 feet and is 54 feet six inches long. Its easily accessible engines allow inspection and repairs during flight, and each major wheel well can be reached from the flight deck for servicing the retracting mechanism.

One of the major aviation mysteries of World War II was the failure of the Army Air Forces to take advantage of the modified flying wing for bombing and cargo-cartying missions. A prominent AAF officer is said to have recommended that, since the Burnelli-type fuselage could carry a bigger payload and carry it faster, no time be lost in developing such aircraft. But nothing was done. The Burnelli fuselage, as compared with the tubular fuselage construction of the conventional transport and big bomber, is as flat on the sides as a born door. Also, wing-fuselage ships can operate from sharter airstrips than needed for planes of comparable size.



operation, a vital factor in today's competition among air lines.

All this is done with the same horsepower as is used by the standard commercial transport.

Burnelli talks in fundamentals. "My design," he explains, "does more work because it departs from the conventional. Streamlining is all right for automobiles and railroad trains. Streamlining, as it is reflected in cylindrical fuselages, is out of place in an airplane. That's because 'skin friction'—the resistance that the airplane skin sets up to the air flowing over it—goes up as airplanes get bigger. At the same time the 'profile drag'—the resistance offered by the shape of the airplane to the air—goes down.

"The bigger the conventional cylindrical fuselage gets, the greater the skin friction on a structure that is sheer dead weight. If you must have skin friction, put the skin to work. That's what the lifting fuselage does."

The Burnelli plane does some other extraordinary things. With a full load it lands half as "short"—that is, uses half as much length of landing run—as any other airplane of similar weight. It will carry more passengers at greater speed than the world's biggest twin-engine airliner. More than 40 passengers can be crowded into it.

Thirty-six can be seated with plenty of leg room. The Burnelli plane has practically the same number of cubic feet of cargo capacity as a cylindrical-fuselage plane a third longer, a fourth wider, and more than half again as high.

Clyde Pangborn, the soldier-of-fortune pilot who flew around the world with Hugh Herndon in 1931 and has done much of the test work on Burnelli designs, marshals some telling arguments for the Texan's boxlike lifting fuselage.

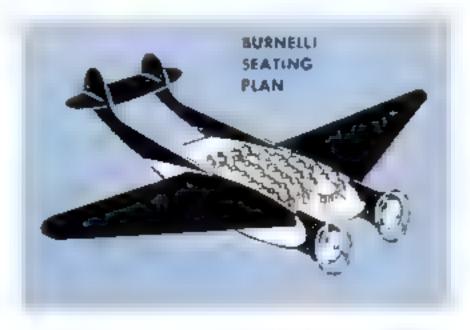
The engines are ahead of all the structure of the plane, he points out. In the event of an accident the engines and their mounts would absorb a large degree of the impact.

That was proved in two crashes in years gone by. In one, in 1923, when the plane's power failed, only one of the four persons in the plane was burt. Oddiy enough, that was Burnelli himself. In the other, in 1935, when improperly attached ailerons let go, neither of two persons in the plane was burt, though everything on the plane was smashed beyond recognition except the fuse-lage.

The passenger and pilots' compartments are surrounded by 65 percent of all the structural weight of the plane.

"The fuseiage of a conventional plane," says Burnelli, "is little more than a shed

The passenger load in the Burnelli artiner is arranged laterally instead of longitudinally as in other planes. This puts the bulk of the passengers in the center of the cabin, away from the windows. At the same time it protects them in the event of accident because the engines, set clase tagether and attached directly to the fuselage instead of the wings, would take the brunt of any impact. An interesting inherent safety quality of the design for over-water operation is the fact that the wide body, made watertight, will serve as a boat bottom for distress landing and will float indefinitely.





The big belly of the CBY makes for a tremendous air-braking surface in landings. The ship needs only 600-700 feet of runway for taxiing in. And with the engines placed class to the plane's center line of thrust, no serious problem of control arises should one of them develop a failure in flight or landing.



Landing gear is designed to accommodate two wheels, giving the plane better grab on soft ground.

to keep the sun and rain off the passengers. Its structural strength is about 15 percent of the whole."

Pangborn also notes that the propellers operate ahead of all the plane's structure and are attached to the fusciage itself, not to the wings. If an engine tears loose, it can't take part of a wing with it. Moreover, he says, the engines are close together, and a failure in one engine poses no question of control because the remaining engine is close to the plane's center line.

Finally, since the body of the plane lifts so much of the total weight, the wings can be made shorter and stronger. Burnelli says the fuselage can be made so rigid and watertight that it would float indefinitely in a rough sea if the plane were forced down on an intercontinental run.

POPULAR SCIENCE MONTHLY took a ride in the new Burnelli plane, built by the Canadian Car & Foundry Co., in Montreal.

Its interior looks as big as a boxcar. It

The slope of the back of the CBY's fuselage resembles a shi run and is 18 feet six inches long from its uppermost forward part to the trailing edge. While at work between flight tests, mechanics padded around on the wings and fuselage and slid down the slope when they wanted to reach the ground quickly.





The RB-2, built by Burnelli in 1924, was called the world's first air freighter. It carried a complete automobile inside, with a showroom arrangement, on a cross-country tour for a car manufacturer.



The C8-16 was produced three years later, it was the first all-metal multi-engine airplane, first to maintain altitude on one of two engines, and first twin-engine ship to have retractable landing gear.

rides nicely. It takes off like a scalded cat and lands like a little two-seated private plane. But due to the width of its fuselage its roll is accentuated in rough air. A passenger sitting next to a window can see an exaggerated up-and-down movement on the opposite side of the cabin as air currents force the wings up and down.

And, of course, only a limited number of passengers can have seats next to the windows. We saked Pangborn how passengers will feel about not being able to see out.

"In the first place, you can see out the windows even if you are sitting in the center of the cabin," he replied. "In the second place, how many people are going to enjoy seats next to the windows in the new conventional 75- and 100-passenger planes now being built? Seven passengers are denied window seats even in the little 21-passenger standard Douglas transport."

The idea for the lifting fuselage was born back in 1917.

"I was designing planes," recalls Burnelli, "and it irked me that the wings absorbed only a small part of the power of the engine. 'Drag' took the rest. The flying wires, struts, and fuselage literally were dragged through the air."

The first Burnelli plane with a lifting fuselage appeared three years later. It flew well. Succeeding designs impressed Gen. William D. Mitchell, who went to bat for Burnelli. But nobody ordered any.

Burnelli is philosophical about that, "The lifting fuselage," he says, "is the first new configuration in plane design since streamlining was introduced. Human beings by nature distrust the unusual. It took years to get the carriage lights off automobiles, and the first railroad trains were nothing but stagecoaches fitted to rails. An airplane that doesn't look like an airplane should look is suspected."

But his logic seems unanswerable. "My plane," he points out, "carries more. It carries it faster. Yet it has a low landing speed. Landing speed is a function of the

safety of operation of a transport plane. The crash impact of a plane going 120 miles an hour is four times that of one going 60 miles an hour."

He adds, wryly, "Keep in mind that motheaten statement that it isn't the speed that kills people; it's the sudden stop."

The ultimate in Burnelli designs—a 100-passenger, eight-engined ship with counter-rotating propellers.





RCA VICTOR screen measuring 16 by 211/2 inches provides high-definition pictures free from distortion.



COST of television set will be determined largely by the size of the screen. For \$100 you will get a 3-by-5 or 7-by-9-inch picture.

Television Manufacturers

ANDREA AIR KING (PATHE) ADMIRAL ANSLEY AUTOMATIC RADIO AIROLA DEWALD BELMONT CROSLEY DETROLA ESPEY FADA DUMONT **EMERSON** FREED-EISEMANN GALVIN FARNSWORTH GILFILLAN GENERAL ELECTRIC GAROD HALLICRAFTERS HAMILTON HAMMARLUND HOFFMAN KARENOLA CORP. MAGNAVOX MAJESTIC MIDWEST NATIONAL PACKARD PHILCO PHILHARMONIC SEARS-ROEBUCK REGAL SCOTT SENTINEL SPARKS-INDUSTRIES STEWART-SONORA STROMBERG-CARLSON TEMPLE WARNER WARWICK WELLS-GARDNER WESTINGHOUSE MARCALI DACON PROBLEM DA EL SÁCIO DA CARACA DE ANTRE DE PROBLEMA DA PARA LA DE LA DESENTADA DE PARTA DA CARACA DE PARTA DA CARACA DA CAR

TELEVISION FOR YOU

ALMOST 50 MANUFACTURERS ARE MAKING HOME RECEIVING SETS, MANY OF WHICH WILL SELL FOR AS LOW AS \$100.

N THE next six months, and maybe sooner, you will be able to walk into a television store and say to the man behind the counter, "I like that one. Wrap it up, please."

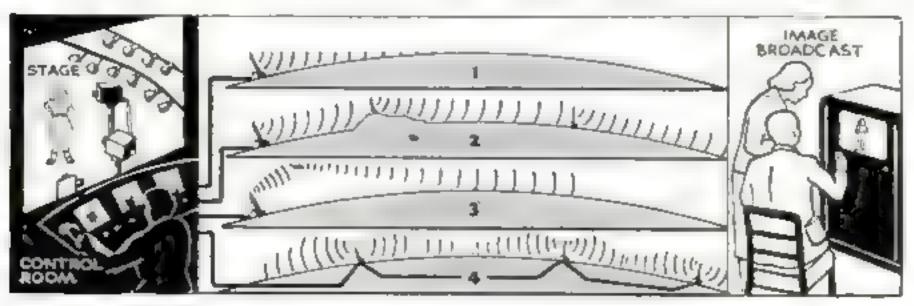
You will get a pretty good picture in your television set, something between the quality of the 16-millimeter home movie and the 35-millimeter you see at your neighborhood theater. If you want to pay for it, you can get a screen far larger than any produced even experimentally before the war. The largest available is almost as big as a full-size newspaper page.

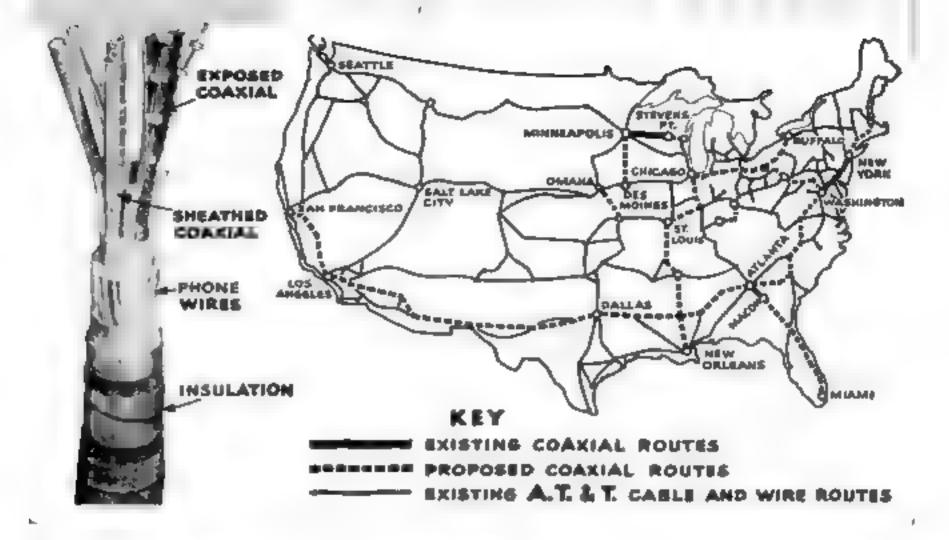
Television is improved because, finally, it

HOW THE RANGE OF TELEVISION BROADCAST IS EXTENDED

MATERIAL (ANTHORISE DE LA PRESENTATION DE LA PRESEN

- Television waves refuse to follow curvature of the earth; tower transmitters broadcast only 50 miles.
- 2 Relay towers erected at 40 to 50-mile intervals, automatic and unattended, pick up and relay signals.
- 3 Transmitters in planes flying six miles up cover a 420-mile circular area, Relay planes extend range.
- 4 Underground coasial cable, laid for telephone use, can be equipped to carry television programs, but it would be a castly method. Repeater stations 80 miles apart would power amplifiers within the cable.





COAXIAL ROUTES to take care of telephone needs, but which some day may form the basis of television networks, will soon span the country. At left is the cable developed by Harold S. Osborne, of A.T.&T.

is coming of age. The war has done much to improve it. What television needed, radar needed. And, to win the war, radar engineers by the thousands had to pioneer in producing better cathode-ray tubes and the timing-synchronizing units that go with them and in the ultra-short radio waves that make the transmission of moving images through the ether possible.

Work now is under way to sprinkle television signals over wider areas, so that in the next couple of years you may sit before your fireplace in Bangor or Beloit and watch the January Rose Bowl game in Pasadena. As against the less than 10,000 receiving sets in operation in the United States today, almost 50 manufacturers expect to market several hundred thousand in the next twelve months and millions in the next five years. Prices start at \$100 and range upward to \$1,000.

New pickup tubes for the television cameras, developed by the Radio Corporation of America, are extremely sensitive to ordinary light and will enable television reporting teams to cover outdoor events in

PLOW TRAIN lays the lead-sheathed cable in the ground, 30 to 36 inches deep. The "rooter" plaw (center) explores the ground for roots and rocks, and then the cable unwinds into the plaw shaft (right).





TELECASTING a scene at Station WABD, Note the microphone boom and array of cailing lights.



CONTROL ROOM where angineers, technical directors, and producers check details of program.

any kind of weather that they may encounter.

Unlike the multiknobbed radio sets of the 1920's, the television receiver will be simple to operate. You will turn a switch to introduce power to the set, push a button for the station you want, and then adjust the picture for contrast and brilliance. The controls you use for contrast and brilliance will serve the same purpose as those you use on

your present radio set to obtain tone control and the proper volume. In a few more years even these controls may be taken care of at the transmitting station.

Only nine television transmitting stations—three in New York, two each in Chicago and Los Angeles, and one each in Philadelphia and Schenectady, N. Y.—are available to the television (Continued on page 210)

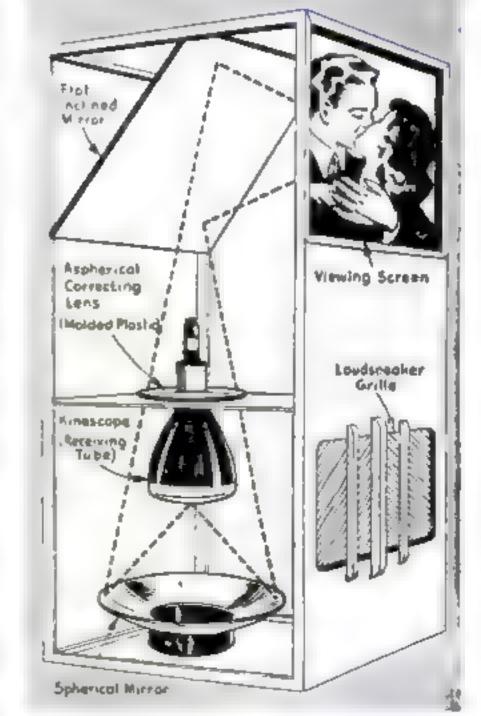


CBS Says:

"It is estimated that color television receivers will be only slightly more expensive than black-and-white receivers . . . This most advanced television system, transmitting images in full color and utilizing the progress made during the war in the field of electronics, will guard against receivers becoming obsolete for a long time to come."



"... Authorities agree that color television will not be acceptable to the public until a fully electronic method has been perfected. Research has made good progress on this problem but ... it is expected that several years will elapse before television pictures in natural color will be available in the home."

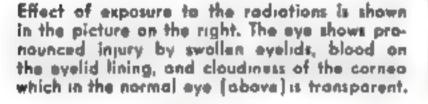


OPTICAL SYSTEM for a built-in television screen. Broken lines indicate path of light beams.





Dr. Wolf studies the eyes of a boby chick exposed to dangerous invisible ultraviolet rays which can cause serious injury to eyesight.







DOES SUNLIGHT HARM EYES?



Exposing chicks to ultraviolet light emitted by the lamps shown. When pratective glass 6 for shields were used, no harm resulted.

INVISIBLE ultraviolet light ranging 300 to 365 millimicrons in wave length (a millimicron measures 1/25,400,000 of an inch) is dangerous and should be excluded from human eyes to prevent impairment of vision. This finding is based on experiments with baby chicks conducted by Dr. Ernst Wolf, of the Harvard Biological Laboratories, and sponsored by American Optical Company

Dr. Wolf recommends that protective lenses should be worn by welders, flyers, and others exposed to the radiations. He chose chicks for the tests because the visual characteristics of their eyes approximate those of a human and because they obligingly keep their eyes open under ultraviolet light.



The set is Takya and its environs, reproduced exactly on a scale of one foot to the mile, ready to be "shot" by Army cameras, Bombardiers and radar men saw the movies, later pin-pointed vital targets.

Now It Can Be Told "SHOOTING" JAPAN

AAF's movies of three-dimensional models of the Jap homeland taught bombardiers and radar men to spot targets at a glance.

Superformers radar men and bombardlers went to the movies before going on missions over the Jap home islands—but not to be entertained. B-29 crews studied special briefing pictures of prime targets made by draftsmen, sculptors, painters, and carpenters of the 18th Base Unit (Motion Picture Unit) of the Army Air Forces at Culver City, Calif. These wizards in khaki reproduced faithfully, in miniature, scores of factories, hundreds of miles of railroads and rivers, whole mountain ranges, Tokyo and its surrounding area, and many warproducing centers.

Reconnaissance photographs were en-

Data on the photographs then were translated into three-dimensional modeling. Proper color values were added by artist specialists trained by experts in Japanese topography. When the sections were completed, they were interlocked with one another to make a complete model of an area. Then the movie camera made its "bomb run" from about a five-foot level above the model. Synthetic radar pictures were made showing how the targets would look in clear weather and through ground haze, clouds, and fog. From these pictures B-29 crews learned the lay of the Jap land,



Mountain ranges, factories, and hundreds of miles of railroads and rivers were laid out in three-dimensional modeling. A specialist covers the rough contours of mountains with plaster. After the plaster is smoothed and covered with green-dyed rubber this will look like Japan's mountain forests.

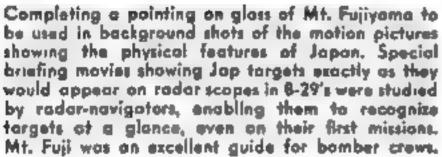


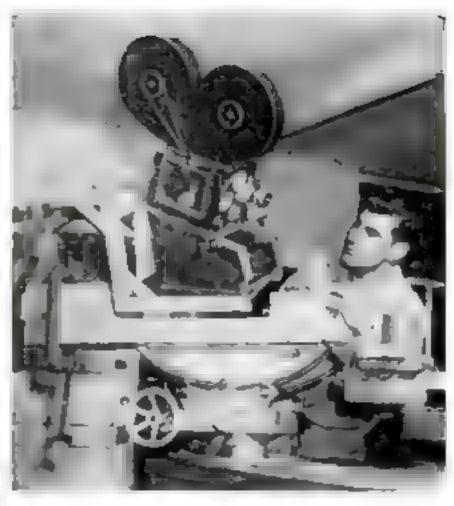
Strictest adherence to details was observed in partraying Jap war-producing centers. In this miniature reproduction of Mushishma, an Army artist paints a target area and buildings to simulate comouflage exactly as indicated on the reconnaissance photograph under the magnifying glass at the right.

Draftsmen, sculptors, painters, and carpenters of the 18th Base Unit (Motion Picture Unit) of the AAF at Culver City, Calif., designing and constructing sets that duplicate Japan's terrain and the cities that were on the 20th Air Force's bombing list. Some 30 targets covering 5,000 square miles were reproduced this way. Then motion pictures were made of them from a moving crone at a height of about five feet. Note the ascending area on the edge of the set, so designed to give an illusion of distance.







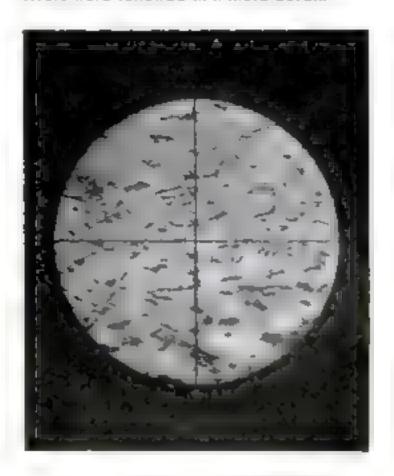


Special mounts were devised to hold the 35-mm, camera that photographed the Jap 'homeland' in a California movie studio. Tipped and tilted during the "bombing runs," the camera recorded the scene exactly as the bombardier would see it from the nose of a Superfortress. By this special rigging the lens was held at the same level above the scenes being pictured while the camera pivoted around it.

Rooring over Tokya aboard a camera dolly! Here you look down from a simulated altitude of 17,500 feet on the AAF's three-dimensional miniature of the countryside approaching the Jap capital. Toward the east, in the upper right-hand corner, is Pt. Chashi, A 8-29 crew would find the real thing exactly like this. Each finished briefing film showed the route to be flown, a visual reproduction of the most important parts of the run, radar scape pictures of guide points, and finally the target. This layout of Takyo and its surrounding area covered 4,800 square feet of space.

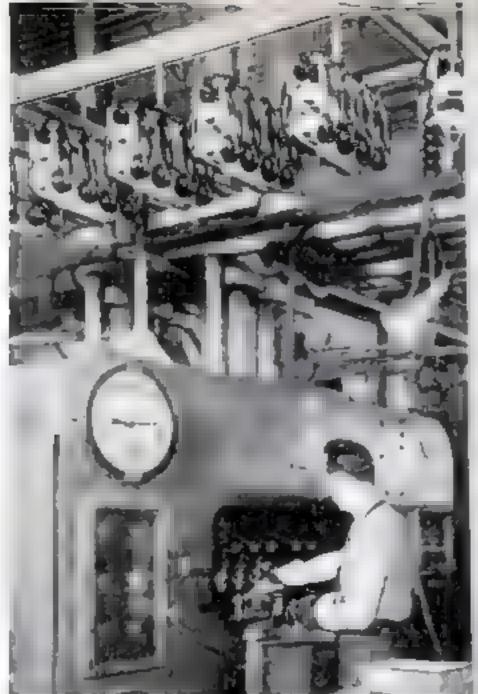


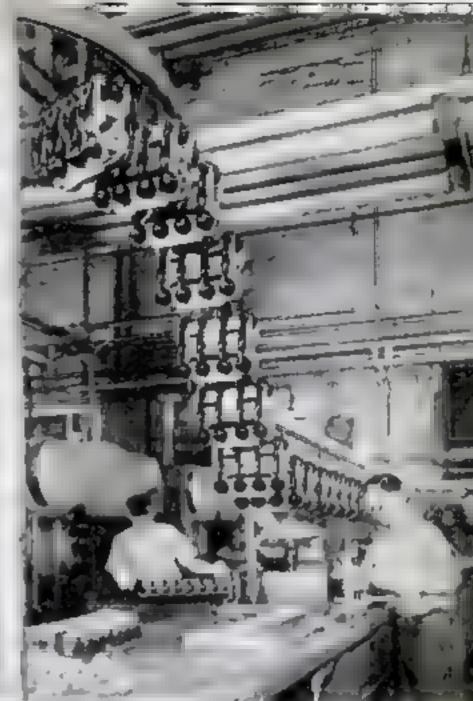
A target is cought in the cross hairs of a bombardser's sight as recorded in the amazingly accurate motion pictures which showed crewmen exactly where to unload their fire bombs and high explosives. Vegetation experts reproduced the pattern of forests and rice fields in the models. Buildings were constructed from matches and toothpicks, railroads were simulated by using copper wire, and the peculiar bends of rivers were followed in minute detail.



76

POPULAR SCIENCE

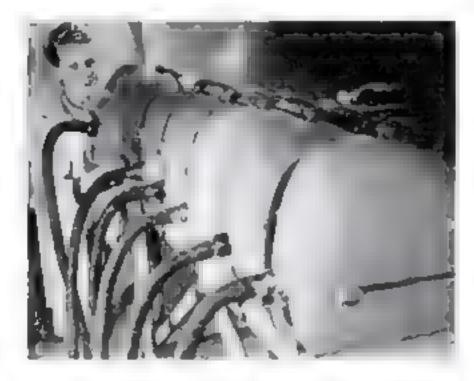




Here's That Telephone You've Been Waiting For

THE production line of telephones for civilian use is moving again at the Hawthorne Works of the Western Electric Co. At present, 100,000 phones a month are being manufactured to end the scarcity created

by military requirements during the past four years. The rate of production will be increased as rapidly as possible. Another problem on the way to being solved is production of cables and switchboards.



Smooth New Vacuums Save Work

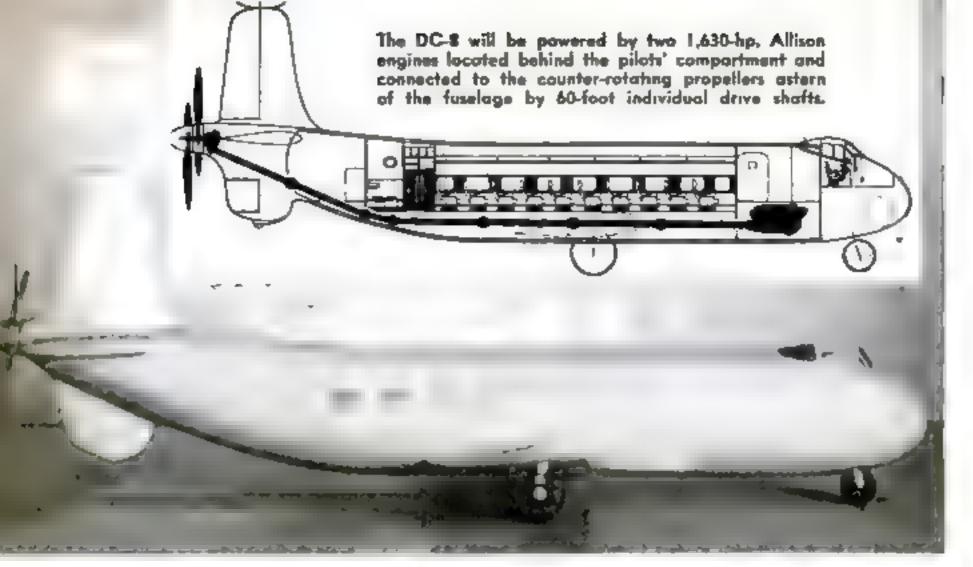
RADICAL streamlining is among the several new features included in the vacuum cleaner made by Timm Aircraft Corp., Los Angeles. Others are a self-reeling cord, self-cleaning dust bag, and an exhaust port with a deflector that prevents air from disturbing dust on the floor. A control adjusts suction for light or heavy fabrics.

New Automatic Garbage Truck

A SELF-FILLING and dumping garbage truck contains a steel compressor plate that automatically packs the load toward the rear of the body, thereby increasing its capacity. The picture below shows the body of the Heil Colecto-Pak in dumping position, with both the receiving end and the tail-gate open, and the garbage hopper at the top of its loading stroke. The hydraulic operation is easily controlled by levers located in the cab or at the rear of the body.



NOVEMBER, 1945



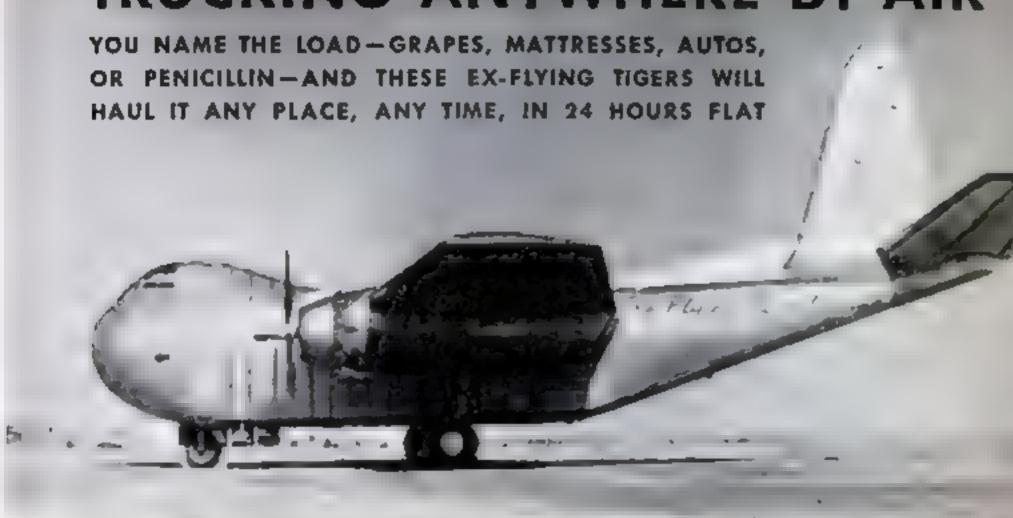
Tail-End Propellers Will Push the New Douglas Air Transport

PROMISING both air lines and the traveling public air transportation "as modern as
tomorrow," the Douglas Aircraft Company
is planning to replace its standard DC-3
with a transport driven by twin counterrotating propellers on the rear of the fuselage. The new ship, to be known as the
DC-8, will be 50 percent faster than its

predecessor and will carry 48 passengers at rates that are expected to compare with coach fares on trains. The remote location of the propellers will mean less cabin noise and the motorless wings will give passengers better visibility. A cabin-floor level only five feet above the ground makes boarding and leaving the ship easy.



TRUCKING ANYWHERE BY AIR



Seven Budd stainless-steel Conestagas comprise the fleet of the Flying Tiger Line. They are part of a group of fast aerial freighters sold by the Surplus Property Board after the Navy canceled a contract.

GI's from over the world are returning home and going into business. Some are looking for ideas; some have them. Here is a story of a group that is making vital year experience pay dividends in peace.

There are 20 in all—every one a former Fiying Tiger in China, in the air or an the ground. They put up half the money and they run what they think may be the most extensive business venture tried by veterans. Certainly, it's a novel one.

By ANDREW R. BOONE

ROM Flying Tigers to flying truckers! Anywhere, any time, they carry freight loads that are needed in a hurry—grapes, mattresses, automobites, or penicillin. You name it and they'll haul it

As proprietors, pilots, mechanics, and roustabouts of the National Skyway Freight Corporation, better known as the Fying Tiger Line, seven former members of the American Volunteer Group have criss-

Large vans back up to the loading ramp leading to the cargo hold of the big twin-engine Conestagus and take on ar discharge goods. The planes fly a fast, nonscheduled service and go anywhere in the world.





Robert W. Prescott, one of the early pilots who flew for Chennault in China, is the mainspring of the freight air line. He conseived the project, taised the maney, and then purchased the planes.

crossed the continent with heavy loads of perishables, medicines, airplane engines things their customers want delivered immediately.

This is no ordinary commercial undertaking. From Robert W. Prescott, president of the air line, who resigned his commission as a Navy ensign to join Gen. Claire W. Chennault in chasing the Japa across China, to the grease monkeys, all of these fellows are former Flying Tigers. Some flew and the others kept the fighters in the air. Every man owns a piece of the company.

Line chief for the First Pursuit Squadron, AVG, Jack Cornelius kept the Tigers flying. Now he's vice president in charge of maintenance for the civilian Tigers, and he still keeps 'em flying.





Joe Rosbert, chief pilot for the National Skyway Freight Corporation, official name for the Flying Tiger Line, was an ensign in the Navy before he joined the AVG and battled the Japs over China.

All of them work with their hands to keep the big freighters flying.

They got out of China alive; they love aviation; they're going to stick together; and they plan to make their company and their jobs—pay.

Prescott, a big, amiable, hard-working pilot, mainsprings the group. It was he who, while flying international freight and passengers in big Douglas C-54's, conceived the idea of a nonscheduled freighter service. Prescott came home—with five Jap fighters and one recon-bomber under his belt—when

Horvey Wirta, left below, once was chief ormorer at AVG group headquarters, and Leon Calquette was chief mechanic for the Hell's Angels Squadron. Both are mechanics now for the Flying Tiger Line.





Moster Sgt. R. J. King was communications chief for all the Flying Tiger squadrons. Head radio man now for the freighter fleet, he inspects an antenna before a transcontinental-trip take-off.



Tom Haywood commutes from San Francisco to Long Beach in his own plane when it's his turn to fly. In China he was Third Pursuit Squadran flight leader. Above, Prescott greats him at the field.

the AVG was disbanded in July 1942. Then he joined TWA's Inter-Continental Division and made a series of important flights, among them the one that carried Ambassador Joseph E. Davies to Moscow with the famous message from Roosevelt to Stalin. Shortly after that he returned to China, joined the China National Aviation Corporation, and flew military supplies over the hump for a year.

He resigned from CNAC last April, and a little while later he was in Washington buying planes for the Axteca Airline. About that time the Navy canceled its contract for the stainless steel Budd Conestogas. Believing in the big cargo plane, Prescott sprang the idea of a (Continued on page 210)



Less than two days after the photo below was made at Bakersfield, Calif., this cargo of grapes and other perishables being loaded abourd a fast sky freighter was sold out in Atlanta, Ga., markets.

Link Laughlin, at the controls of a Conestaga in the picture above, pilated a P-40 fighter for the Flying Tigers in China. This former lieutenant in the Marines is still at it—now it's freight.



The Globemaster is powered by four Prott & Whitney Majors, Its four-blade Curtiss reversible propellers enable the big ship to back into a hangar.

Two jeeps are hardly naticeable in the vast interior of the C-74. Fitted for commercial runs as the DC-7, it will carry 108 passengers and crew of 13.

GLOBE GIRDLER

Douglas C-74, carrying 30-ton cargo, circles the earth at 300 m.p,h., making two stops.

LOBE GIRDLER—that's the new, low-wing Douglas C-74 Globemaster, first transocean transport plane capable of flying nonstop to almost any point in the world. Big brother of the C-54 Skymaster, the Globemaster can carry 30 tons of cargo 7,500 miles at speeds above 300 miles an hour. It can transport 125 troops from California to England without sitting down for fuel. A commercial version, the DC-7, will carry 108 passengers and a crew of 13.

As a military carrier, the Globemaster can haul huge cargoes of jeeps, tanks, trucks, howltzers, and sirplanes. It is equipped with its own loading elevator, operated by two traveling cranes supported on overhead rails in the cargo cabin. A swinging stationary crane, located at the large cargo door forward, also helps.

Part of the big plane's speed is derived from a laminar-flow wing, here employed





The "bug eyes" of the Globemoster give both plot and cop of 360-degree visibility. Its dual wheel fanding gear is retractable and its built in loading elevator lifts a 30-tan payload about in a lifty.

for the first time on a large plane. The C-74 is equipped with retractable trivice landing gear and powered by four 25-vinder Pratt & Whitney Major R-43:0 engines, using either four-blade Curtiss or three-blade Hamilton Standard reversible propellers Separate enclosures or big eves 'give both pilot and copilet 3:1 degree visibility

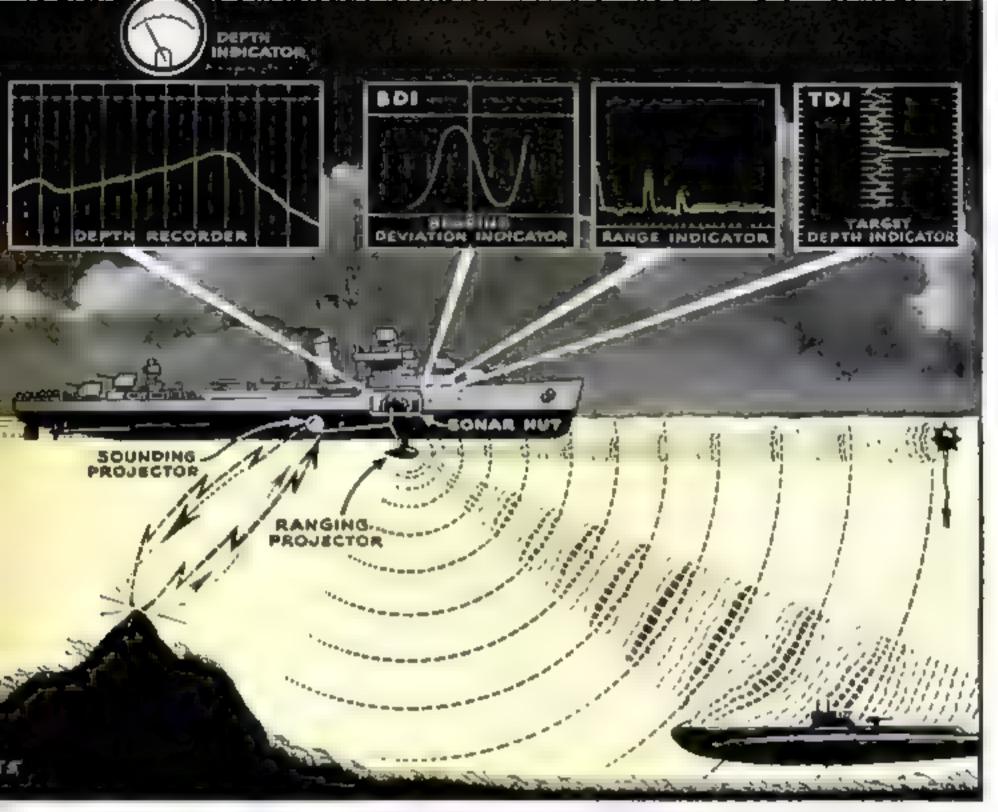
Langer than the B 29 Superfortress by 25 feet and with a wing span 32 feet greater, the giant ship carries 11 000 gal, as of gaseline more than could be contained in

a standard railroad tank car its carg compartments have nearly twice the cubic totage of a beyont, and it will carry twice as many passengers as a street-ar

Cab n and flight personnel quarters are and matically heated so that the interior remains confortable even when the outside temperature is 50 below zero. Electronic centres maintain an even heat distribution. Electronic controlled benters keep the piles win ish close clear and free from ice, while all wing and tail surfaces are there had the electronic and tails writers are there.

This sky grant carries (1 000 gallons of gasaline which will take it 7 500 miles at 300 miles on hour. The wing span is 173 feet length is 124 feet, and the tail towers nearly 44 feet above the runway.





High-frequency sound waves, bouncing back from underwater objects, trace patterns on ship's sonar scopes.

The RADAR OF THE DEEP

By JAMES L. H. PECK

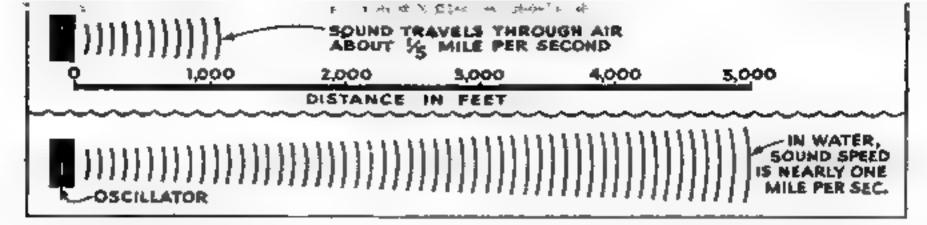
Secret eyes and ears installed in the bottoms of ships to thwart submarines now are helping to protect seafarers from perils of navigation, including the hundreds of thousands of mines still strewn around the world. Sonar (submarine detection and ranging) devices are a new means of both exploring and exploiting the seven tenths of the earth's surface that lies beneath the oceans. They can be used not only by mariners, to avoid reefs, wrecks, and mines, but also by fishermen and naturalists, to hear the grunting, purring, croaking, and drumming of fish.

Sonar includes listening gear, ranging equipment, and sounding apparatus. In this "Davy Jones's radar," high-frequency sound waves are used instead of radio waves. But electronics and magnetism have been linked with sonic science to detect and locate objects below the sea more swiftly and cer-

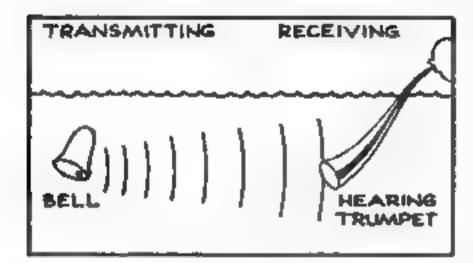
tainly. Underwater menaces have been located miles away, and torpedoes racing at 40 knots or faster toward a ship have been detected and traced in time for the vessel to dodge them.

A metallic football on a retractable rod below a ship, or a bulge in its bottom, suffices as a sonar "antenna." On most ships, the other equipment is housed in a small cabin called the sonar hut, occupied during the war by men whose lips were sealed for the sake of security. In a submarine, duplicate instruments may be placed in the conning tower and forward torpedo room, and sound-wave projectors may be located on top as well as below the hull. Even if a landlubber could see the projectors, he would not be likely to guess how acutely they hear and interpret echoes in the depths.

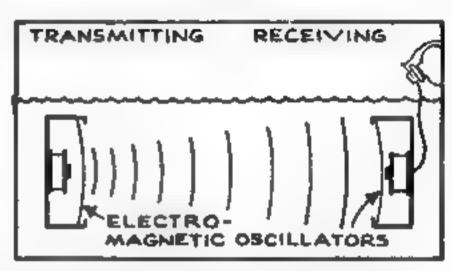
The man-made waves emitted and received by these new "feelers" figured in the battles of the Atlantic and the Pacific, but sonar's work is far from done. The British



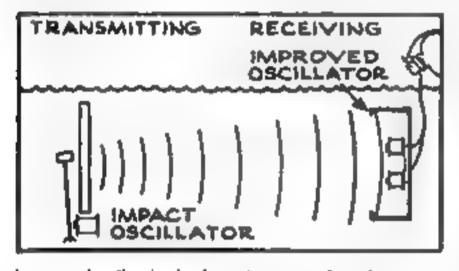
Water transmits sound nearly five times as fast as air. It is an ideal medium for sound-detection work,



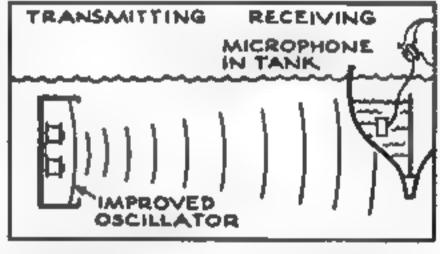
First underwater ears resembled Granny's trumpet.



Fessenden oscillator used diaphragms, magnets.



Improved mike had phone-type receiver in water.



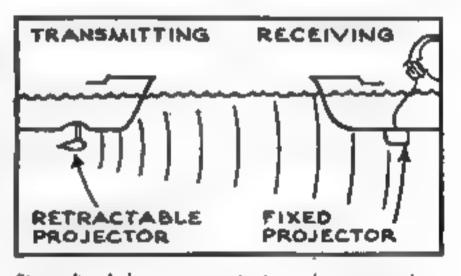
Putting the mike in a tank cut out "water naises."

. . . S O N A R

Navy alone laid 260,000 mines during the war; our submarines, minelayers, and B-29's turned Asia's ports into death traps; and the Japanese set mines adrift in ocean currents sweeping toward America. Sonar will lessen the dangers in peacetime from these and other menaces.

The variety of sonar devices already in use is startling, and more are being developed. Engineers are working now on small, inexpensive equipment for pleasure boats—and on fish detectors to save the time of professional fishermen.

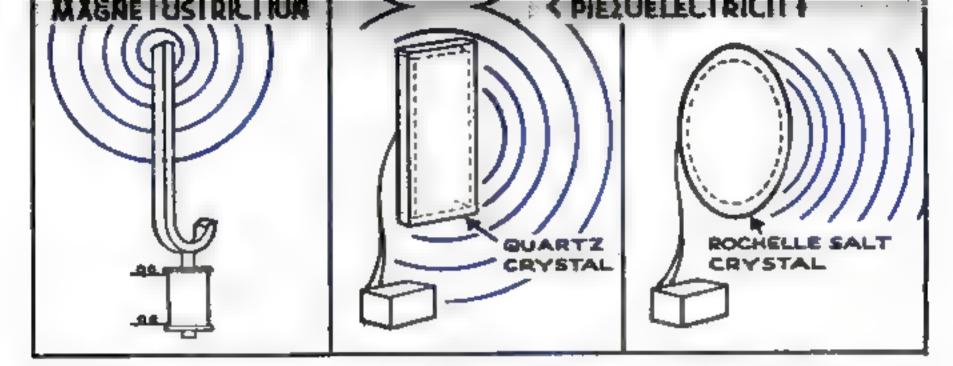
Production of a 90-pound electronic depth recorder for peacetime use is planned immediately by the Marine Division of the Bendix Aviation Corp. This instrument consists of a signal sender, an echo amplifier, and a recording mechanism that draws an irregular purple line on a roll of scaled paper as the ship sails over the mountains and canyons below the waves. This makes it as easy for a mariner to get the lay of the



Streamlined housings protect modern projectors.

ocean's floor as it is for him to glance at the headlines of a newspaper. He merely looks into a window to see the contour of the bottom of the sea.

If the ship passes over a wreck, the line of the graph becomes heavier; if a school of fish swims below the ship, tiny lines on the graph reveal their presence. The operator of this particular apparatus, moreover, needs no special training to use it to search for buried treasure, navigate through fog by following hydrographic charts, or to locate fishing banks and schools of fish.



Steel bar magnetized by ofternating current vibrates rapidly.

Some crystals change in size when excited by electricity.

Rochelle-solt crystals are used in most sonar ranging equipment.

When Mark Twain was a Mississippi steamboat pilot, the boatmen took soundings by hand and called out "Mark Twain" when the water was two fathoms deep. This new sonar device does such work faster, more accurately, and in deeper water than any man could do it. When measuring the depth in fathoms, 48 soundings a minute are taken, which means that a ship doing 10 knots gets a reading every 21 feet along its course. When the depth is being measured in feet, 288 soundings are taken a minute, or every 3½ feet by a vessel doing 10 knots.

This will facilitate the commercial use of the great rivers of Africa, South America, and other continents, as well as make navigation of the high seas safer. Developers of the new supersonic depth recorder contend that it can be used with hydrographic charts in fog and darkness with more confidence than a magnetic compass.

Much of the romance may vanish from fishing, however, for sonar will show new-

comers the location of fishing banks which have thus far been the closely guarded secrets of old-time fishing-boat captains. Devices which cost less than a net are being made for commercial fishermen now. They are expected to pay for themselves, not only by helping to locate fish, but also by disclosing the rocks and wrecks on which nets costing up to \$3,500 are often torn.

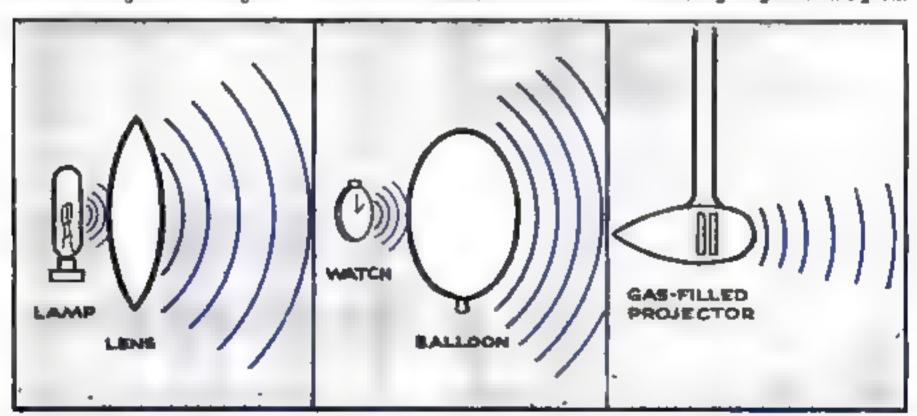
Experienced ichthyologists, tuning in on the conversations of fish, now can tell what varieties of fish are making the noises. But visual depth recorders, so sensitive that they indicate the presence of fish and their favorite haunts, will probably suffice for commercial fishermen's purposes. Fishing by the seat of one's pants may soon be as discredited as flying that way.

Like radar, sonar grew out of a long series of inventions. Sound travels faster and farther through water than through air, and devices to pick up the sounds of submarines were invented before World War I.

As a glass lens intensifies light, sound lens magnifies some signals.

Gos-filled balloon makes ticking of a watch audible across room.

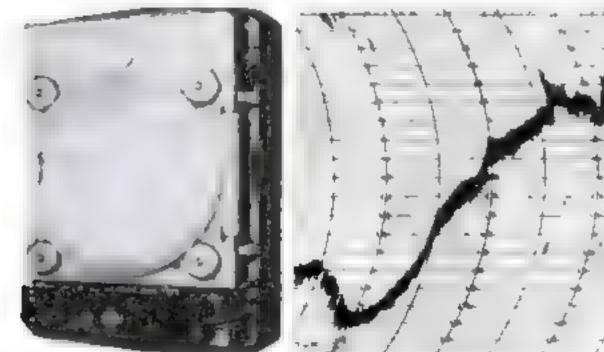
Carbon dioxide in sonor projector housing magnifies all signofs.





FISHERMAN'S LABORATORY. With this experimental vessel Bendiz technicians tried out their supersonic depth recorder and other instruments

for peacetime use. When employed for locating schools of fish, the portable "transducer" shown here can be transferred easily from boat to boat.



RECORDER CHART is marked with a purple line that traces the outlines of the hills and valleys on the ocean Roor. This is an actual record of the

voyage from Block Island, off the top of Long Island, to Flushing Bay. The prominent dip is the floor of Plum Gut, a deep depression in Long Island Sound.

The first underwater ears had thin diaphragms stretched across openings, like old-fashioned speaking trumpets. Underwater bell buoys and oscillators were developed as warning and communication devices. Receivers were improved and placed in tanks within ships to reduce undesirable water noises. Ordinary sounds gave way to supersonic vibrations, beyond the range of the human ear, and sonar communication methods were so improved during this war that ships could converse by sonar when it would have been dangerous to use radio.

Whether sonar is being used for signaling, or to listen for objects beneath the water, or to detect them by emitting waves which bounce back and are timed like radar waves, the signals can be made either audible or visible. When desired, sonar can be set to ring a buzzer or flash a light when a ship approaches shallow water.

One sonar device has a sonic lens to magnify the sounds or echoes detected. Any change in the composition or temperature of a medium conducting sound changes the velocity of the (Continued on page 246)

WHAT'S NEW



French Substratosphere Transport Was Hidden from Nazis

THROUGHOUT the occupation of France, this Beliatrix substratosphere transport plane lay camouflaged and hidden at Draguignan, unknown to the German invaders. Designed by the French engineer Parot, the

sleek 12-ton sky liner includes an insulated cabin for high-altitude flying. Its two engines give it a top speed of 300 m.p.h. and a cruising speed of 257 m.p.h., with a range of 1,250 miles.

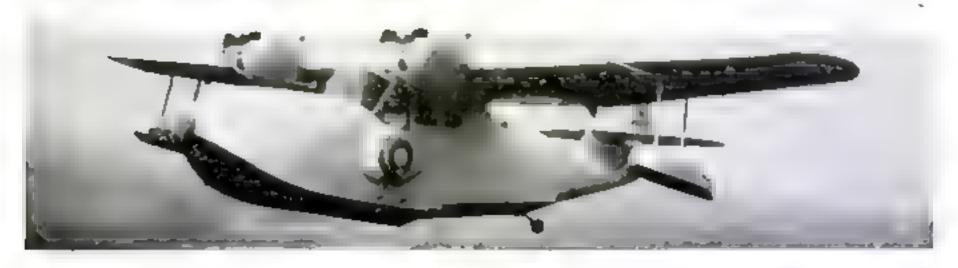


Fuel Injection Spurs B-29's

SUPERFORTRESSES that dropped the atomic bombs owed their quick getaway to the new Bendix-Stromberg direct-fuel-injection system illustrated at left. Fuel is pumped into each cylinder through a stainless-steel fuel line and the nozzle shown.

Lightplane Is Flying Camp

Here's a personal plane in which a sportsman can fly to his favorite lake, land on the water, and live aboard ship while he hunts or fishes. The Trimmer amphibian, designed by Gilbert G. Trimmer for Commonwealth Aircraft, Kansas City, has a built-in galley, and its three seats can be made into two comfortable bunks. Two 85-horsepower engines give it a cruising speed of 115 m.p.h., with 600-mile range. Landing wheels are retractable, and the hull serves as a float in the water.

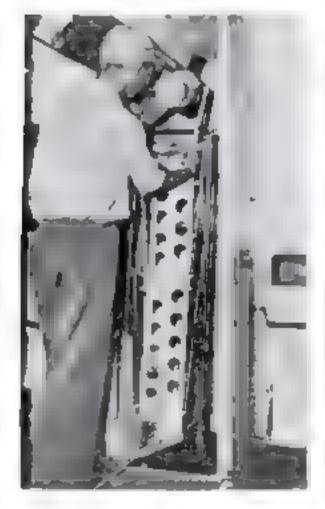


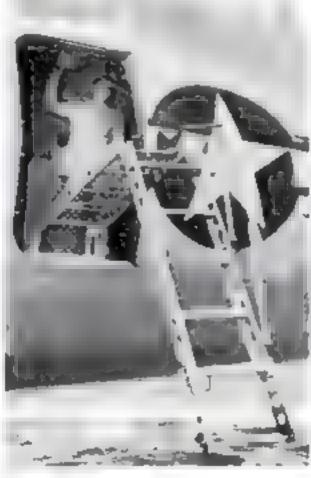


Big Cargo Planes Carry Their Own Gangplanks

Disembarking from a large air transport is simplified by an electrically operated collapsible ladder designed by a civilian employee at the San Diego naval base and adopted by Douglas Aircraft Co. When not in use, the ladder is stowed beside the main

cabin door, as shown in the photograph at left, below. On landing, the ladder base and the overhead cable motor are moved into position in the door opening on short tracks, and the hinged ladder is lowered. A bandrail unfolds with it.









In jungle and an coral the Navy built more than 400 Pacific sea and air bases on the road to Tokyo. The long runways at Torokina on Bougainville, built in a month, are typical of Navy speed in setting up a "home."

NAVY'S ISLAND EMPIRE

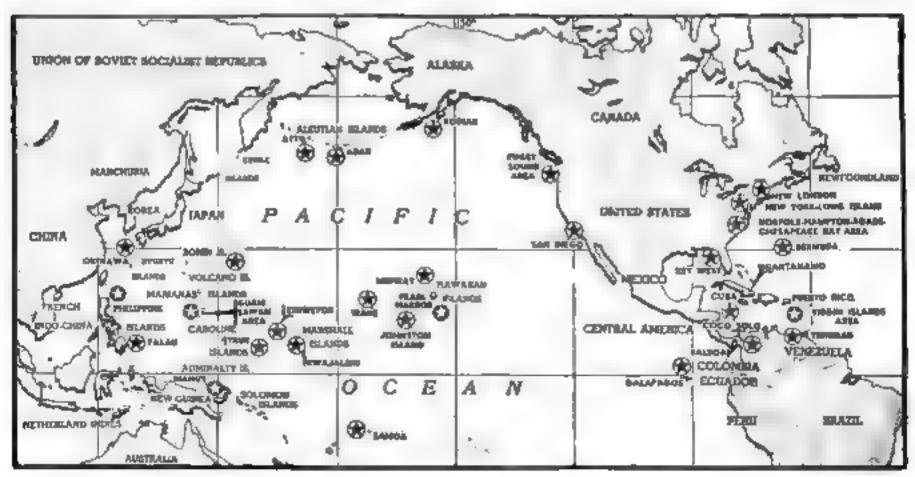
AMERICAN FLEET WANTS TO KEEP NETWORK OF WORLD BASES

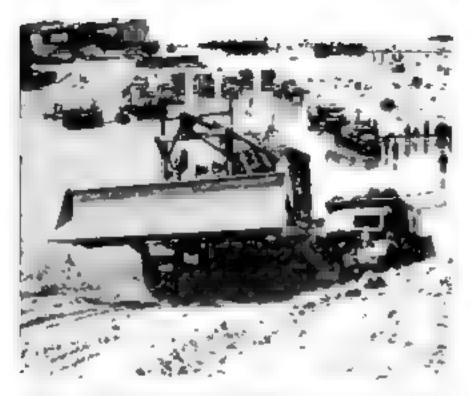
REAT, roaring construction machines continue to carve out the United States Navy's permanent, peacetime advance base needs in both the Atlantic and Pacific oceans. Peace, which ended the shooting, only intensified the base-hungry Navy's efforts to secure its strategic stranglehold on Japan, its shock-absorbing sea and air anchorages against aggression.

Fifteen major bases, nine of them in the Pacific (see map on this page), were proposed as necessary by the Navy in its request for funds to make them assaultproof and equip them for their strategic purpose.

Fleet bases have four primary functions. They must be used for supplying the fleet; furnishing air support; and repairing and maintaining forces affoat and in the air. Also, they must be equipped sufficiently for use as staging areas for personnel and supplies for attack purposes. All of these functions require construction on a vast scale, construction that is roaring ahead at the present time on a day-and-night basic, with Seabees and Army Engineers tumbling work records on every shift.

The Navy wants to hang on to its "island empire," mushroomed from the oshes of the stalen domain of the Rising Sun, and its built-up Atlantic bases. White stars denote major bases, black stars secondary bases.





Saipan—Dynamite and buildozers led the way for heavy equipment to build and maintain airstrips.



Bougainville—Seabees leveled grant trees in laying out bomber fields, and they often come under fire.

Bases, besides the dock and harbor facilities and the vast airstrips, must contain homes for thousands, power, fuel, food, and recreation operations on a scale dwarfing some of the nation's industrial cities. On Guam, for example, 113 acres of covered storage, hospitals with a bed capacity of 9,550, seven main and 125 branch telephone exchanges, a water system of 15,000,000 gallons per day, and 113 miles of paved roads have been constructed since the Island was retaken. On Tinian, 39 miles of runways have been built; asphalt surfacing, on airfields alone, would pave a highway from Washington, D. C., to Boston. On Saipan, enough cable for power and communications has been laid to reach from New York to Ban Francisco 335 times.

Kwajalain—Specially constructed steel mats carpet on area which the enemy had fled only days before.



In the Philippines, where nature is the greatest obstacle construction men must overcome, 12 naval installations are nearing completion. Scabees, during the early days of the invasion, stood helpless while heavy equipment sank out of sight in the mud when removed from landing craft.

Starting with the bases available to the United States Navy on December 7, 1941, a total of 434 have been used during the war in both the Atlantic and Pacific. On June 30, 1945, the Navy estimated that the cost of construction, excluding the cost of labor or technical materials, was over two billion dollars. Cost of the vast expansion shead has not been officially estimated by the Navy, but generally is considered to be in the neighborhood of another two billion.

Eniwetok—Seabees' sledge-hammer blows pulverized ocres of coral into sand enlarging former Jap field.



"Stratovision" and FM Radio from Planes 30,000 Feet Up?

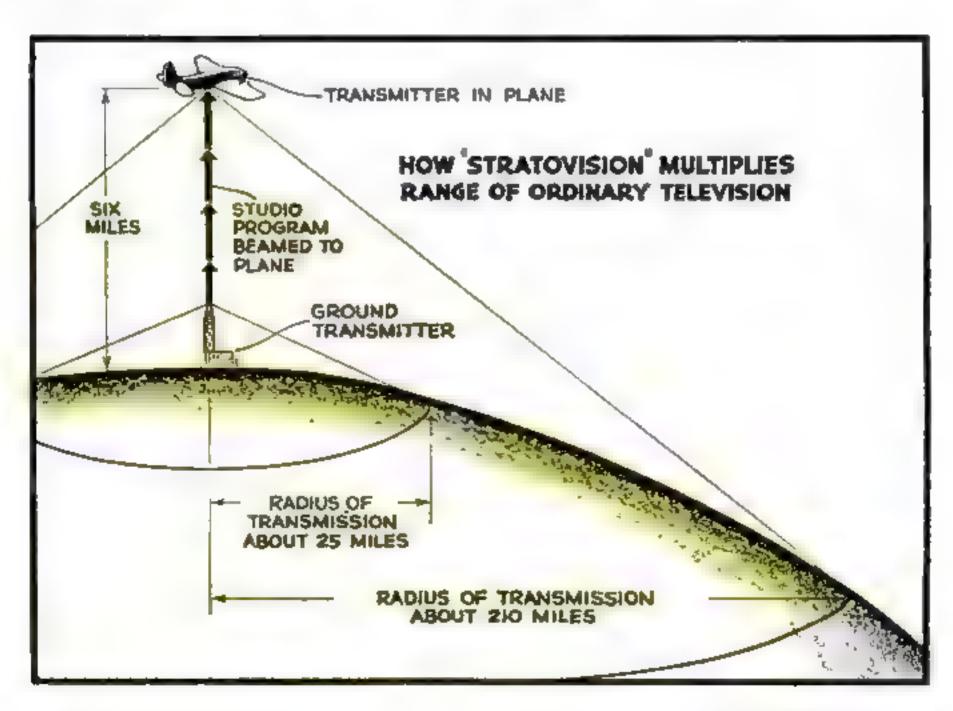
Cy-modulation radio broadcasts transmitted from airplanes flying six miles up are now getting their first flight tests. This new system of televising from the stratosphere is the result of joint research by the Westinghouse Electric Corporation and The Glenn L. Martin Company. Using 14 planes specially designed for high-altitude operation, the two companies confidently expect their "stratovision" system—guaranteeing clear reception and sharp images, including color television—to reach 78 percent of the population from the Atlantic to the Pacific.

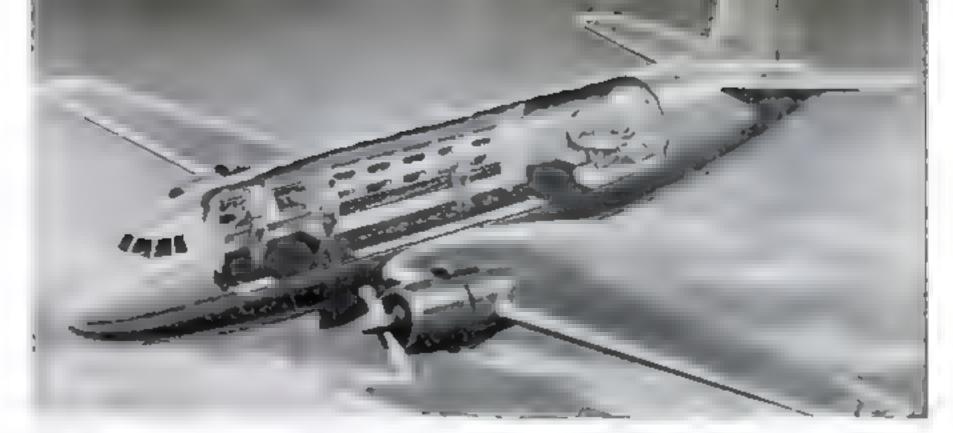
Television and FM radio waves travel in a straight line and for all practical purposes stop at the horizon. This means that broadcasts from the highest practical tower erected on the ground are dissipated short of 50 miles unless picked up by a relay tower (see page 70). A coast-to-coast network would require approximately 100 costly relay towers and hundreds of transmitters. The stratovision system, however, simply puts the antenna and transmitter in an airplane flying in lazy circles 30,000 feet above

the earth. The waves sent out cover a circular area 422 miles in diameter and at the same time relay the program to the plane circling in the next area. In this way 14 planes could cover the most densely populated areas of the United States.

An added advantage of the stratosphere station is the comparatively small amount of power needed. Charles E. Nobles, Westinghouse radar expert and originator of stratovision, points out that one kilowatt of power in a plane will impress a satisfactory signal on a receiver 200 miles away, whereas a ground station requires 50 kilowatts to deliver the same usable signal approximately 50 miles. Also, he estimates that operation of a single plane would cost about \$1,000 an hour, compared with \$13,-000 for sufficient ground stations to cover the same area.

The Glenn L. Martin Company has designed an all-metal, low-wing monoplane almost as large as the famed B-29, but with a gross weight only one third that of the Superfortress, as a flying television station. It will be powered by two 1,450-horsepower engines, cruise at less than 150 miles an





This Martin sky giant was specially designed to serve as a stratosphere station for transmitting television and frequency-modulation broadcosts. Equipped with four television and five FM transmitters, and carrying a three-man flight crew and six radio technicians, it could provide nine simultaneous programs.

hour, and have a top speed of 266 miles an hour. In addition to its transmitters and monitoring and relaying equipment, each plane will have a galley and a lounge for the flight crew of three and the six radio technicians.

Although weather is no problem at 30,000 feet, the planes will carry the most modern blind-flying and anti-icing equipment to insure safe ascent and descent through bad weather at lower altitudes. Each of the 14

national transmission areas will have four planes, with two in the air at all times—one handling programs and the other standing by to take over in case of an emergency. Sufficient fuel will be carried to keep the ships aloft at least 11 hours.

In addition to its four high-altitude planes, each broadcast location will have a fully equipped smaller plane to televise special events and relay programs to the parent plane for nation-wide presentation.

Fourteen planes circling laxily over strategic areas would serve 78 percent of the population from coast to coast. Television and FM studios located in the cities marked on the map would feed programs into the planes for rebroadcast over each plane's line-of-sight area by means of the broadcast antenna. For special events beyond any given area, a smaller plane would relay programs to the nation-wide hookup.









NONREFLECTING GLASS

CHEMICAL COATING ON LENSES OF CAMERAS AND EYEGLASSES INCREASES THEIR EFFICIENCY AND KILLS ANY ANNOYING GLARE

By GOLD V. SANDERS

Photographs by HUBERT LUCKETT

IGHT that bounces back into our eyes from the countless glass surfaces we look at every day has now been brought under control. It can be made to turn back on itself and go the other way. This scientific achievement is one we probably shall not fully appreciate until we actually see how it can relieve us of everyday annovances we have come to take for granted

Reflections from windows, clock faces, spectacles, and many other surfaces blind us to a certain extent. We can see through such surfaces only by getting into position where the reflection does not strike our eyes. Scientists are never satisfied with things as they are, so they have found a way to make almost all of this light pass through glass. That way it adds to our ability to see, instead of subtracting from it as in the past.

Low-reflection glass coatings are in general use thus far only in optics, and almost

Vivid detail of the background as well as the subject a features are captured through a coated lens. "Ghost images" here are reflections from various lens surfaces. Cooted lenses will eliminate them.







Dr. F. H. Nicoli of RCA shows how the etched portion of plate glass lets in light ordinarily reflected.



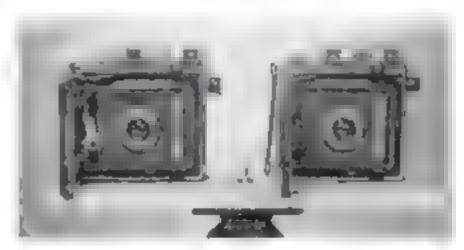
Cloudlike reflection of light forms only on the uncoated part of these lenses. Coating eroses glare.

exclusively in those optics used by the Army and Navy—cameras, gunsights, range finders, binoculars, and so on. The increased efficiency of lenses and prisms with the surface coating is so great that the process has been a must in military equipment for the past year and a haif. Surface coatings now applied are reported to be almost as durable as glass itself.

Perhaps the first widespread use of coated glass by the general public will be in the form of spectacle lenses. Here it will be a comfort to the wearer in reducing glare spots, especially those formed by light coming from behind. When looking at a person wearing this kind of glasses we will see his eyes more clearly with less interference from spots and streaks of reflected light. In other words, the glasses are less noticeable.

The coating of spectacle lenses has been begun by Bausch & Lomb, one of the

companies that has ploneered in developing the coating process. The lenses must first be ground and polished by the optician to your prescription. Then they are sent to the factory in Rochester, N. Y., for the surlace treatment. Opticians, themselves, may



This setup was used by the Popular Science cameraman to compare a coated lens with an untreated one in similar cameras, Results on apposite page.

Greater transparency in automobile windshields is gained by treating the glass by a secret process lieveloped by the American Optical Co. This clearer visibility will be a positive preventive of accidents.





LENSES getting 4/1,000,000-inch-thick coating of fluoride in a special vacuum glass bell jar.



RACK holds 18 large lenses for fluoride treatment at the Eastman Kodak Co. Another rack, however, can handle 500 tiny lenses at the same time.

PELLET of fluoride is dropped into a tontalum "bout" where electricity vaporizes it for spraying.



soon have their own coating equipment.

Next in line for the nonreflective treatment probably will be automobile windows, windshields, and instrument-board dial covers. In this usage it will be a positive preventive of accidents by killing off confusing reflections inside the car. Visibility through all the glass of the car will be improved. This will be no help in reducing the glare of the other fellow's headlights, of course—that is quite a different problem.

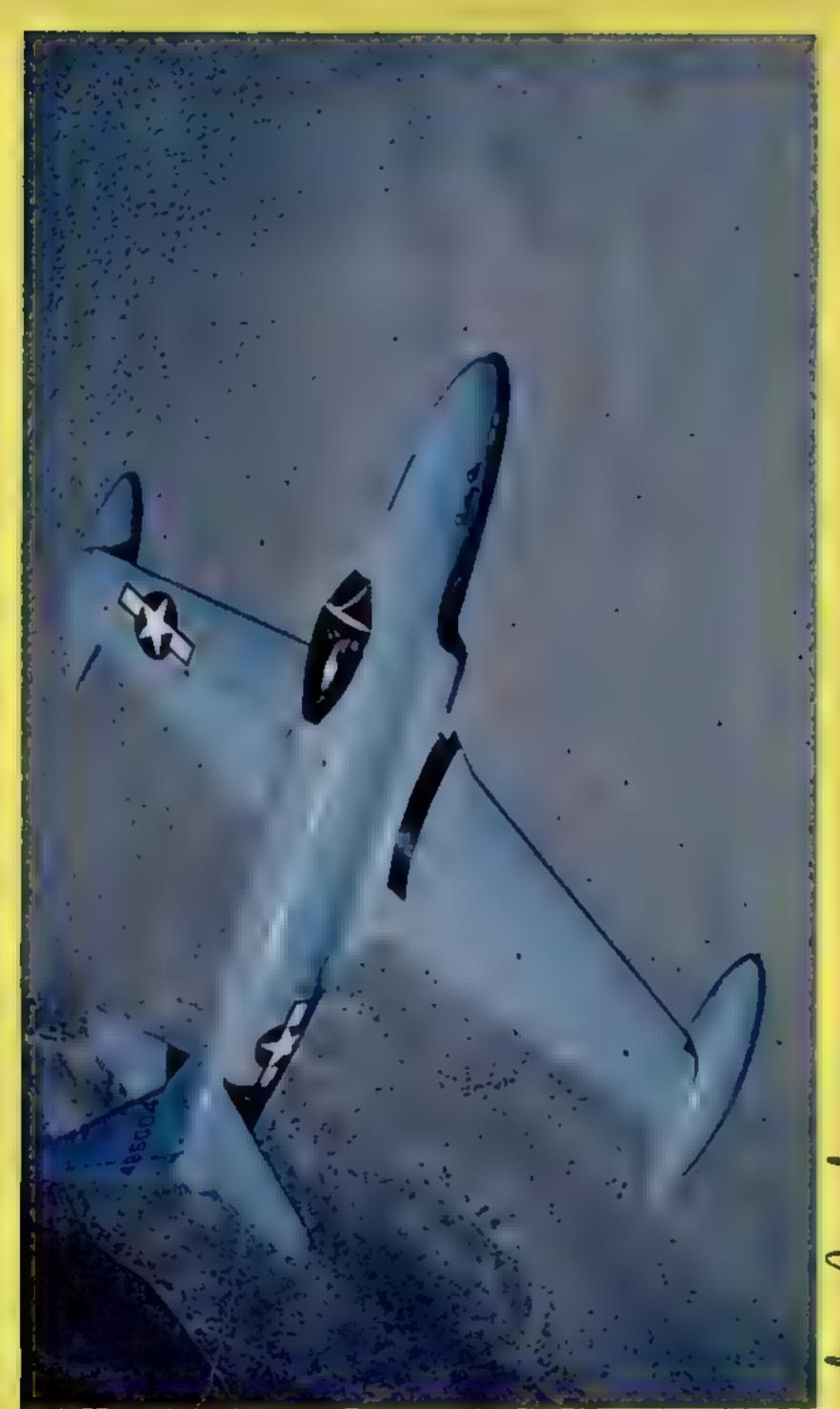
Other possible uses for low-reflection glass are many. If the treating processes can be simplified and done at low cost we may eventually use it everywhere. Store owners will surely want it for their show windows when it is available in plate glass of large size.

It is a tricky way the scientists hit upon to make light waves behave so that the rays usually reflected by every glass surface are made to go on through, or at least all but a very small percentage of them. They found that a surface film exactly one fourth as thick as the length of a certain light wave would prevent reflection of that wave. Rays that attempt to bounce are "thrown out of phase" by this coating, which means in effect that they are forced to go on through the glass or lens.

All this is accomplished by a film four millionths of an inch thick. That's pretty thin. A thousand of these films stacked one on top of the other would not be as thick as a postcard. For maximum results the film should be of material having an index of refraction equal to the square root of the index of refraction of the glass to which it is applied.

Magnesium fluoride, vaporized and deposited under high vacuum and heat, produces a film of great durability and comes close to meeting the other requirements. It is deposited on lenses and prisms in specially made glass bell jars. The fluoride molecules attach themselves to the surface of the heated lenses progressively. Measurement of the film thickness, microscopic though it is, can be done easily by factory workers so long as they are not color-blind. The color of light reflected from the lens surface undergoes a change as the film grows in thickness. When it arrives at a certain shade of purple the process is stopped, for that means that the film thickness is one fourth the length of the yellowgreen light wave. It happens that this is the color of light most useful to human eyes in distinguishing details, so it is the part of the spectrum we wish to salvage and make work for us, not against us.

The urgent demand for coated optics by the armed services compelled manufacturers to step up this (Continued on page 240)



Joun Olin-Up

has a ceiling well above 45,000 feel and speed that approaches that of sound. Armoment is six ,50 caliber LOCKHEED P-80 SHOOTING STAR. Powered by a General Electric Turbo-jet angine, the P 30 With a wing span of 38 feet 10% inches and a length of 34% feet, the P 80 can take off with a gross weight of 14,000 pounds. Auarhory fuel tenks under the wings are used for long range missions

Fodochrome by first to liet



A French clock in a Buhl-work case, made in Paris about 150 or 200 years ago. The decoration is tortaise shell in-laid with brass, a technique perfected by one André Boulle.

Reproduction of a clock dating from 545 B.C. Water trickling into a small bucket fills it in 12 minutes. When the bucket emptles itself, it turns gears to record the time.





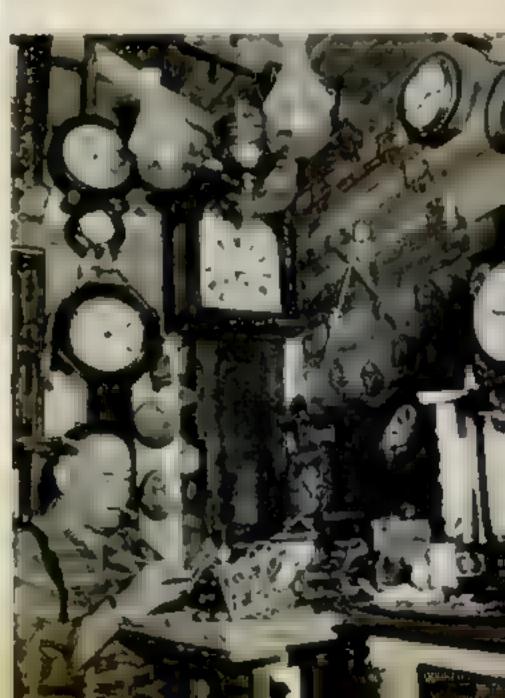
Oversized showpiece Ingersall watch with a heavy chain is one of Willey's 400 timepieces.

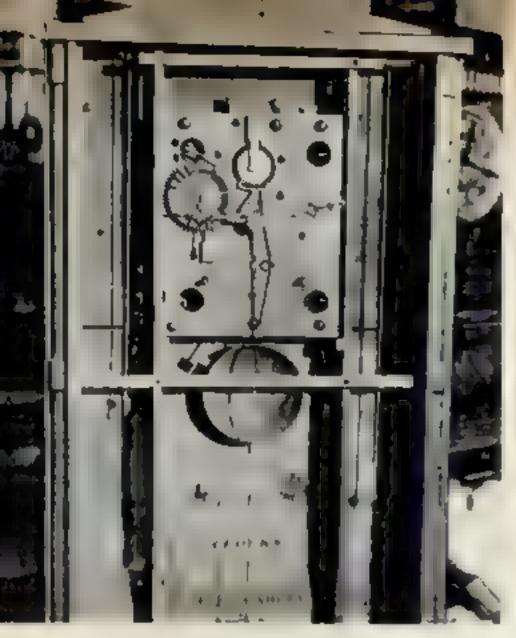
HE HAS TIME FOR A HOBBY

Photographs by G. WEBER

Lyck Willey, Compton, Calif., tick off about one and one tenth years. That's because Willey has over 400 of them, and most of them are kept wound and running. He has timepleces of various sizes and periods from all over the world, ranging from miniatures to tower clocks that require weights dropping three stories. They include a calendar clock that not only keeps track of days and dates but adjusts itself for leap years. Part of his collection is shown here.

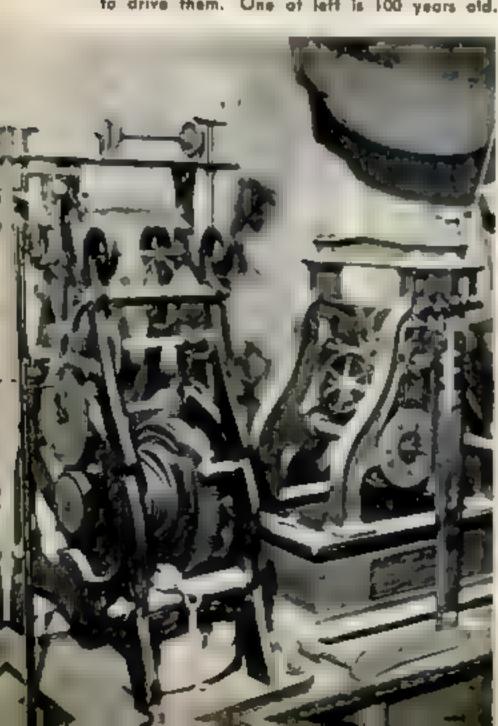
Jack Willey in the midst of his clock collection that ticks off a year and tenth every day.





This century-old clock is shown backside-to because its chief interest lies in the wooden works. The entire movement, including gears and pinions, is carved from wood. And it still runs.

These two massive clock movements are for controlling the hands—generally four sets—of tower clocks. Over 300 pounds of weights are needed to drive them. One at left is 100 years old.







Photographs by WILLIAM W. MORRIS

This picture plaque of pressed flowers and feres was made especially for Popular Science Monthly by Helen Park.

A box of frash-cut flowers arrives at the studio, where Miss Park selects the most attractive blossoms for her unique process.

The Paints With Howers

Helen Park preserves their fleeting beauty by pressing and mounting them in glass.

N YOUR grandmother's spare bedroom, like as not, there were some nice old color prints of flowers. Smart modern homes use pictures that have all the color and charm of the plush-era prints, but they have this big difference: they are made with the actual flowers. Helen Park, New York furniture designer, originated the process, which she calls Crystalique.

Some of the porch furniture Miss Park designed had spaces for growing plants. While working with a pot of ivy, she was struck with the decorative effect of the leaves; it made her wish she could embody it permanently in the furniture. That led to experiments with a glass-topped table, with the ivy pressed between two sheets of glass. The effect was good, and from it her present method was evolved.

Pressed flowers usually make you think of something you find in an old, long-forgotten volume; maybe a larkspur that has faded to the color of bleached-out khaki, ready to fall apart at the lightest touch. The new process preserves the natural colors, with only slight variations, if the

The blossoms are carefully scissored off one by one, the cut being made close to the calys. This gets them ready for the first pressing operation.

2 Flowers are laid out on the drying sheet. Pansies are among the most satisfactory for this purpose; they retain their vivid color and markings.







3 After 72 hours of pressing between absorbent poper, the flowers are removed from the sheets, ready for decorative use or filing away in cabinet

4 To hold them fast, the pressed flowers are fixed on the base glass with a drop of clear plastic cement. Then cover is put an and edges sealed







and a

flowers are kept out of direct munlight and

away from unusual heat.

Into the Park studio comes a box of freshly cut flowers of a dozen different colors, the kinds depending on the season of the year and what the florist happens to have in stock. One by one, the stems are clipped off close to the calyx, and the blossoms are placed, face down, on a sheet of smooth paper toweling, each completely separated from the other. When this sheet



Pressed flowers not needed for immediate use are enclosed in glassine envelopes and kept in a filing cabinet. Flowers retain their colors indefinitely.

is full, another sheet is laid over it and covered with several thicknesses of newsprint. Additional sheets are filled with blossoms and similarly covered until there is a pile a foot or more high. Sheets of corrugated board are interspersed to provide ventilation. Then the pile is covered, top and bottom, with sheets of composition board. The flowers are ready for pressing.

The squeeze is put on in a sturdy, old-fashioned bookbinder's press that is made of cast iron and weighs half a ton. Pressure is regulated by a heavy spider, with hand grips, working on a screw. Miss Park's visitors find it amusing—a piece of machinery that size for pressing flowers.

After 24 hours, pressure is released and the blossoms are removed to clean, dry paper towels; fresh newspaper interlining is substituted; and the pile is again put in the press. The same thing has to be done three times in all before the flowers are ready for use by the artist, or for filing in glassine envelopes. The studio file usually carries a reserve stock of 25,000 flowers of various kinds. Blossoms pressed in this manner are not as fragile as you might suppose; deft-fingered young women handle them with assurance.

Miss Park's method of applying the flowers to mirrors, plaques, transparencies, and other adaptations is to place a drop of clear plastic coment to the calyx side of the blossom and fix it to the surface.

Flowers are not covered with any liquid before applying to the glass, because coating would spoil their texture, but green leaves, including ferns and ivy, are coated with a solution, an important ingredient of which is Canada balsam. When the flower decoration has been arranged, the artist covers it with a shield glass the same size as the base, and seals the edges together with Scotch tape.

One has to consider the anatomy and chemical composition of flowers in selecting blooms that can be used for this process. Obviously, you can't do anything with the heavier double flowers; even the smaller lilies are out, too; they'll go brown. So will violets, either blue or white. But there is a fairly long list of flowers that may be used with good effect.

Flowers are squeezed in this half-ton press for a total of 72 hours. Three sets of absorbent paper are needed to remove all the maisture from them.



KEEP-COOL HAT for hot weather. A compartment in the crown would accommodate a supply of suitably controlled dry ice that would evaporate slowly, making the wearer comfortable on the hottest days. The hat should be of special value to explorers, scientists, sportsmen, and others who have to work under the tropical sun.

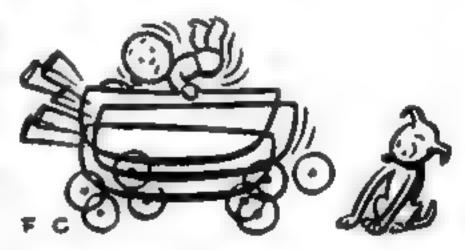
中心 自由於在人物為不過在國際一個的情報不過是於中華中心在不過



HOT, MEDIUM, OR COLD shower by thermostatic control at the touch of a button.
The bather would not have to mess around
with two hard-to-distinguish faucets and
run the risk of either parboiling or freezing himself. Button controls should be
definitely labeled for bather's safety.

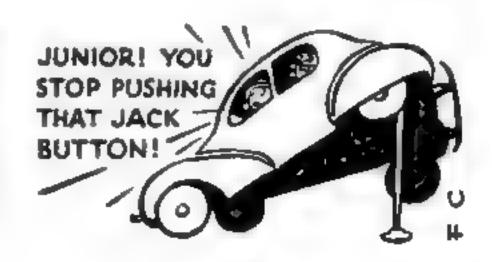
TRIPLE-DUTY SUITCASE with retractable wheels, a seat on top, and a collapsible back rest would solve travel problems. Wheels would enable the traveler to be independent of porters; the seat and back rest would make size sitting a pleasure.

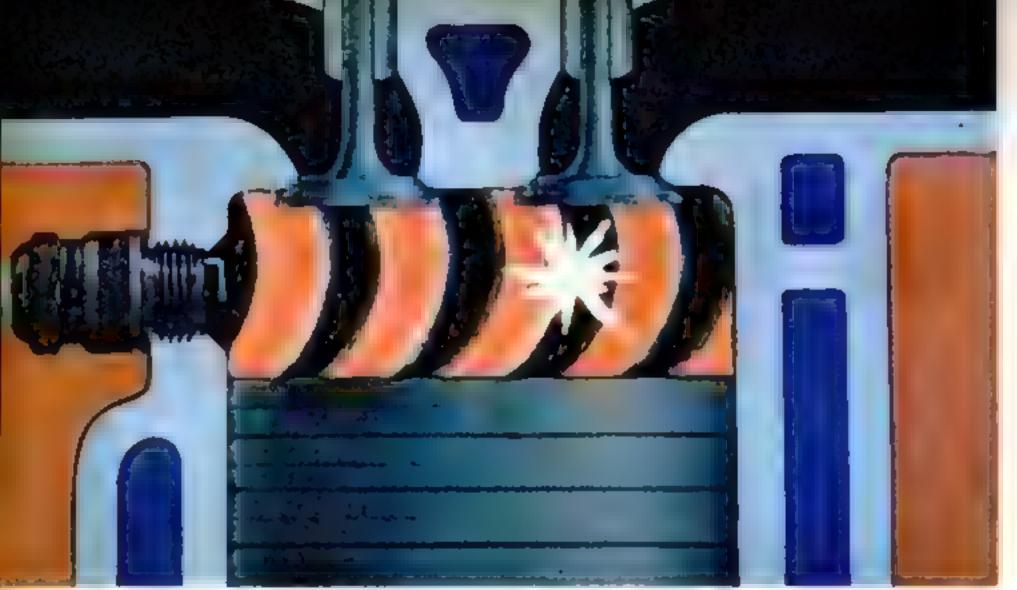




JiGGLE CARRIAGE FOR JUNIOR. The idea is keep the child vocally quiet by setting the carriage in motion with a spring-driven or electric motor. Such a device is designed to save wear and tear on the parent, if not on the baby.

AUTOMATIC JACKS built into the chassis of an automobile would save a lot of mess and fuss when tires go flat. Operated by the car's engine, either hydraulically or by means of gears, they could be controlled by buttons on the dash. If the left-front tire went flat, for instance, the driver would press the corresponding button and the jack would go into action, raising the wheel off the ground.



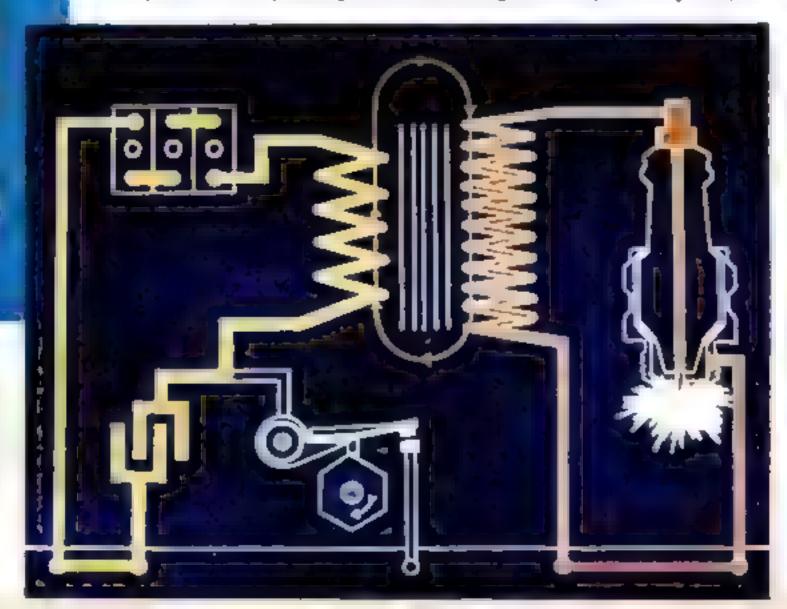


A wave of flame moves across cylinder when properly adjusted plug fires, forcing piston smoothly downward.

HERE'S HOW A SPARK PLUG WORKS ... AS PICTURED BY WALT DISNEY

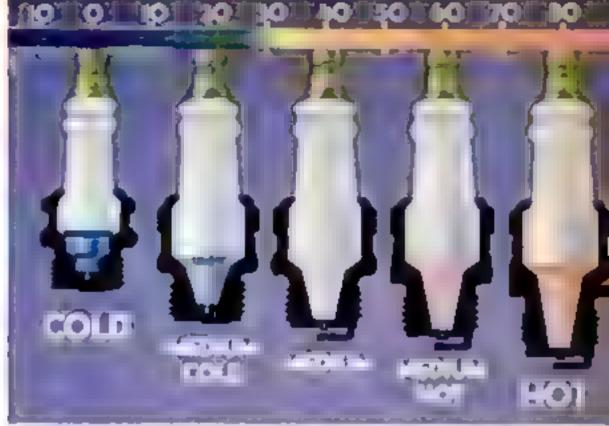
ARE you wasting gas and losing power by using the wrong spark plug in your engine? Better check for your car must still last for a long time. These animated drawings made by Walt Disney for The Electric Auto-Lite Company, reveal dramatically what makes a spark plug tick and how to remedy the most common troubles.

SPARK IS BORN. Current from battery sets up magnetic field linking primary and secondary windings in the coil. Voltage is built up, creating the spork



ASSEMBLY. Plug consists of a special steel shell, triple-seoled insulator, and electrodes comented and welded in place. Electrodes (circled) are the business and.





PROPER PLUG. Hot plugs for cold engines, cold plugs for hot engines. That's the rule! Long-nose but plugs hold heat langer and are better for older engines. But a too-hot plug causes rapid burning of electrodes and blistering of insulators. Also, it may start prefiring of the gas mixture.

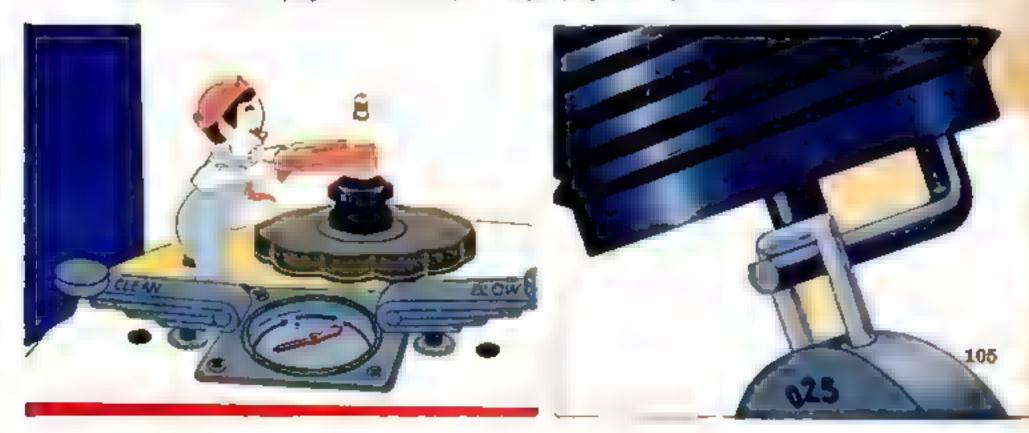
Satisfactory spark-plug operation, say Auto-Lite engineers, requires that the insulator nose and electrodes be maintained at a temperature sufficiently high to burn off carbon accumulations, but not so high as to cause preignition (firing of the mixture before the spark occurs), fusing or blistering of the ceramic surface, or rapid erosion of the electrodes. Proper temperatures, in turn, depend upon the use of hot plugs in cold engines, and cold plugs in hot engines—in short, the correct plug for your engine.

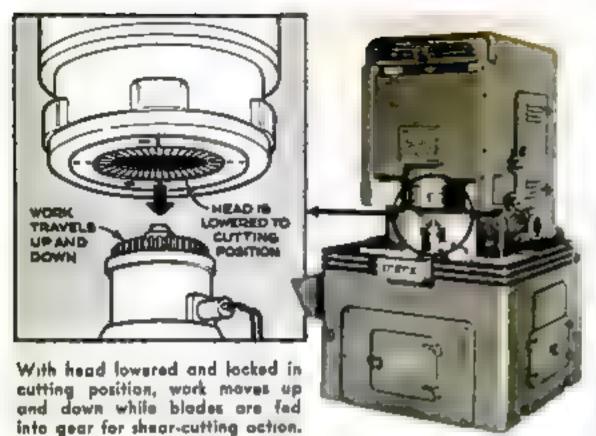
In general, as your car grows more road-weary, you need hotter plugs to fire the gasoline. Other factors making for care in plug selection and maintenance are piston wear, reduced compression as a result of service, and oil leaking past the piston rings. An inspection of the insulator tells a true story of the plug's condition. If the nose is blackened, the plug may be operating too cold and carbon has deposited on the firing tip; if the nose is burned or blistered, the plug is too hot. Normal operating temperatures burn away deposits.



CARBON TROUBLE. When a plug too cold for the motor is used carbon forms on the insulator nose, causing shorting and missing

CARE SAVES WEAR. "Johnnie Plug-Chek" (lower left) shows how to clean grease and dirt off old plug to prevent loss of voltage. On old or new plugs the gap between electrodes (lower right) must be exact for plugs to do their job. Right plugs save gas and promote smoother running.





NEW Jools

NEW METHOD SPEEDS CUTTING OF GEARS

ALL the teeth of a gear are cut simultaneously in a new method developed by Michigan Tool Co., Detroit. Using radially fed form-tool blades with a shear-cutting action, the "Shear-Speed" cuts 60 to 100 or more gears an hour.



COLORS IDENTIFY PLUG GAUGES

Colorgo plastic collets in double-end plug gauges show which end is which. Above is the Dublife gauge made by United Precision Products Co., Chicago. Standard Gage Co., Poughkeepsie, N. T., uses the same idea.

TRIGGER "FIRES" SOLDERING GUN

SHAPED like a pistol and operated by pulling a trigger, the handy soldering gun below heats in five seconds. The small heating tip fits into tight spots for radio and electrical repairs. Since the tip cools as fast as it heats, there is no danger of burns. It operates on 115-volt circuit. Weller Mfg. Co., Easton, Pa., makes it.





A QUICK-SETTING VISE

IT TAKES only a second to open or close the Quikcet machinist's vise manufactured by Grand Specialties Co., Chicago. A push on the free jaw (above) closes the vise; when a trigger is pressed (below), the jaws open to their full three-inch width.





FASTER PICKUP FOR WATER SLASHES TRAIN SCHEDULES

LOCOMOTIVES on the New York Central System now pick up water from track pans at speeds up to 80 miles an hour, thanks to improvements in the method first tried out by this railroad 75 years ago. Trains used to have to slow down to 35 m p.h. to fill their tanks this way. A scoop (above) mounted on the tender is lowered to dip into the pan set between the rails. About 5,000 gallons of water is taken on in 2,000 feet of scooping distance.



PLASTIC CONTROLS ROCKET JET TO GIVE GREATER ACCURACY

ONE reason for the accuracy of U. S rockets, it has been revealed, is the use of plastic "inhibitors" to make the propellant burn evenly and produce a steady jet. Cross-shaped plates of Tenite, like that shown above, are placed at the ends of the cruciform fuel grains (P.S.M., Aug. '45. p. 68), and rectangular "webs" of the same material cover the sides. These control the burning of the fuel and regulate the jet.



"PEEL" PROTECTS METAL PARTS FROM RUST DURING SHIPMENT

VITAL replacement parts shipped to U. S. bases in all parts of the world arrived as bright and shiny as when they left the factory, in spite of exposure to dust, sait air, or tropical moisture. A "plastic peel," put on by dipping the part in an ethyl cellulose plastic, had only to be stripped off (below) to expose the clean metal. The coating was perfected by the Hercules Powder Co. and Dow Chemical Co.









Sunbathing in winter. We are told that when this picture was taken, the autside temperature was 17 below zero F., and there was no artificial heat in the house. The secret is in the double-paned windows, sandwiching a sealed-in layer of dehydrated air. In summer, unwelcome heat is excluded by the wide eaves, as shown at the left and below.

Sun Helps Heat "Solar House"

O LD SOL is your furnace man, if you live in a solar house like this one shown in a new "Popular Science" film produced by Jerry Fairbanks in co-operation with this magazine.

Heat from the winter sun is brought into the house by large south windows consisting of double panes enclosing layers of dehydrated air. Artificial heat is needed only in the mornings and evenings, even in the coidest weather. In summer, wide caves cut off the rays of the high-riding sun.

An air-conditioning system pipes radio and phonograph music through the house.



SCALE MODEL OF "OLD IRONSIDES," FIRST BALDWIN LOCOMOTIVE

A FIVE-TON wood-burning locomotive named "Old Ironsides" was the seed from which sprang the great Baldwin Locomotive Works of today. In 1831, Matthias Baldwin, a Philadelphia jeweler, built a miniature engine to run on a circular track in a museum. As a result, he got the job of building a full-size locomotive for the Philadelphia, Germantown, and Norristown Railroad

When the new iron horse was completed in Baldwin's shop, he had to tear away part of the walls to get it out.

The photograph above shows a model of Old Ironsides made largely of wood and cardboard. Accurately scaled at a half inch to the foot, it can be built without the use of a lathe. You'll find the plans for this historically interesting model on page 166.



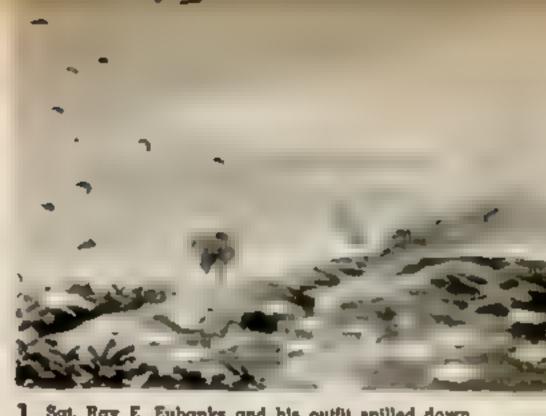
"PACIFIC PUDDLE-JUMPER," NAVY'S NEW LANDING CRAFT, CARRIES TANKS AND TRUCKS

HERE'S one of the Navy's newest landing craft, designated LSM
(Landing Ship, Medium), photographed off Okinawa. Sized between the LST (Landing Ship,
Tank) and the LCT (Landing
Craft, Tank), this 200-foot oceangoing vessel is designed to ferry
light tanks, half-tracks, and gun
carriers at high speed over considerable distances. On the beach,
the snub bow is opened and a
ramp is lowered to pour men and
machines ashore.

He Told the Japs:

GET UP AND FIGHT!

The story of a gallant paratrooper whose one-man raid on a New Guinea strong point scrambled a big Jap force and earned him the Medal of Honor.



2 Sgt. Ray E. Eubanks and his outfit spilled down on Noemfoor Island, New Guinea, in July 1944, but all were planed down by Japa holding a ridge.



4 Eubanks then went out alone to scoul a way to the ridge. Returning, he found his platoon leader killed.



5 Using the knowledge he had gained of the terrain, he took two men and inched ahead five more yards, but the Jape peppered every moving vine to stop them.

8 With his rifle rendered useless and himself wounded, Eubanks charged into the midst of the enemy position under heavy rifle, machine-gun, and grenade fire. Brandishing his weapon, he yelled, "Come on, get up! Get up and fight!" routing the surprised and scared Japa before they could stop him,





2 That night the company commander planned a new attack. Eubanks' equal was told to strike on the right.



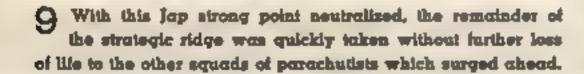
3 They advanced to within 20 yards of the Japa when the enemy heard the sergeant warn his men to keep under cover. Nip machine-gun sluge soon whistled by.



6 Eubanks told the two men to "freeze" where they were, and he wormed forward by himself, moving up stealthly and silently.



When he was 15 yards from the enemy position, he opened fire with telling effect. But many Jap guns spit back, hitting him and breaking his rifle.



10 Eubanks lay dead beside the battered bodies of four Japs killed by the butt of the heroic GI's automatic rifle.





What can you tell about this navy man?

His Story

F YOU will use a sharp eye here, mateys, you will be able to tell a good deal about what Frank J. Savage of the U. S. Navy did in World War II—and, as a matter of fact, even before the war began.

In keeping with the tradition of "the silent service," Navy men disclose less of themselves and their war records as they walk down the street than Army men do. However, from Frank Savage's insignia and decorations, you know approximately when he entered the Navy; his rank and pay; whether he is a line officer or a member of a specialized corps; where he has served; his combat experience, and whether he has been cited for distinguished conduct.

Rank of naval officers is indicated by sleeve stripes on dress and blue service coats, and by shoulder marks on white service coats, mess jackets, overcoats, and working uniforms. For all officers below flag rank, shoulder marks correspond to the sleeve stripes worn on blues, denoting rank by the number and width of stripes.

An important distinction to remember in connection with the Navy is that between line and special-service officers. A line officer is one who is qualified to command a vessel or group of vessels of a specified class. A special-service officer belongs to one of the specialized corps.

Last month, POPULAR SCIENCE presented an Army man—Sgt. John B. Welde—in a study of insignia and decorations. In this, the second of a series, see how many of the questions below you can answer. Then check your results on page 114. Seven correct answers is a good score.

SEE HOW MANY QUESTIONS YOU CAN ANSWER

- What is Frank J. Savage's rank in the Navy?
- 2 To what branch of service does he belong?
- 3 to be a "line" or special-service officer?
- 4 What is his monthly pay?
- 5 Did he enter service before Pouri Herber?
- 6 Did he serve in the American Theater?
- 7 Did he serve in any aversees theater?

- 2 in what oversees theater, if any?
- 9 Did he distinguish himself in combat?
- 10 is he credited with extraordinary hereism?
- 11 How many major engagements was he in?
- 12 Did to sere any decoration more than exce?
- 13 in what compalant did be take part?
- 14 Was he wounded in action?

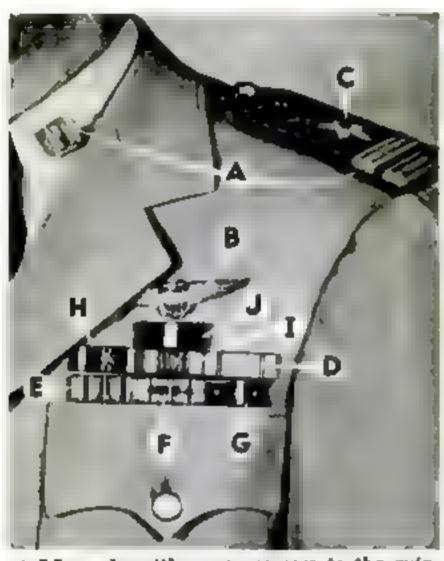
This close-up of the insignic and decorations on Frank J. Savage's left breast will give you some clues to his naval career and war record. Here's a hint: the Navy uses the same theater ribbons as the Army to denote service in the various parts of the world.



Is on His Jacket!



WHAT'S YOUR SCORE ON NAVY INSIGNIA?



ALL ready with your answers to the quix on Navy insignia and decorations on page 1187 Here are the facts about Frank J. Savage, as recorded on his uniform:

 Twin bars (A) on his cap, shoulder boards, and shirt collar show that he is a lieutenant. A full lieutenancy in the Navy is the equivalent of a captaincy in the Army.

2. The wings (B) on his left breast show

that he is a naval aviator.

3. That he is a line officer is shown by the star (C) on his shoulder boards. If he were in some special service, such as supply, the star would be replaced by the emblem of the service corps.

4. He draws \$462 a month, if overseas and married. Single men and men not on

overseas duty draw less.

. 5. The American Defense ribbon (D) at the right in the upper tier proves that he entered the service before Pearl Harbor.

 Service in the American Theater is recorded by the ribbon (E) at the left in the lower tier.

7. Ribbons at center and right in the lower tier stand for overseas service.

8. Ribbon (F) represents the Asiatic-Pacific Theater. (G) is the Philippine Liberation ribbon.

 He must have distinguished himself in combat. The Distinguished Flying Cross
 (H) and the Air Medal (I) indicate this.
 The single ribbon (J) above the two tiers, representing the Navy Cross, proves that Lieutenant Savage distinguished himself "by extraordinary heroism in connection with military operations against an armed enemy."

11. He was in four major engagements, as indicated by the four little bronze stars on the Asiatic-Pacific ribbon. Two of these were in the Philippine Liberation campaign, since there are two stars on that ribbon.

12. Gold stars on the Distinguished Flying Cross and Air Medal ribbons stand for citations in lieu of a second award of these two decorations.

13. Philippine Liberation ribbon is as near as any of his decorations come to identifying any particular campaign.

14. The absence of the Purple Heart ribbon indicates that, for all his combat action, Lieutenant Savage went through the entire war without being wounded.

The cap insigne is the regulation officer's eagle with spreading wings, perched atop a shield, bearing 13 stars and 18 stripes, superimposed on two crossed anchors.

FROM Lieutenant Savage himself must come the full story of his career as a naval aviator. He entered the service in May 1941 and became an aviation cadet in September of the same year, training at the Naval Air Station at Corpus Christi, Texas. Commissioned March 12, 1942, he was assigned to an escort scouting squadron at the Sand Point Naval Air Station, Seattle, Wash.

He went to sea twice, first for eight months beginning in December 1942. Assigned to a torpedo squadron, he took further training at San Diego and went to sea again in April 1944. He was relieved of sea duty in March of this year and is now assigned to a naval torpedo station at Newport, R. I.

In the Battle for Leyte Gulf he scored a torpedo hit on a 25,000-ton Jap carrier to win the Navy Cross. The first DFC citation was won with a torpedo hit on a Jap cargo vessel at Hong Kong, the second with a glide-bomb hit on a tanker off the Pescadores. The first Air Medal citation came after he put a torpedo into a cargo transport off Okinawa, the second when he repeated the performance off Formosa.

Lieutenant Savage is 27 years old and a native of Arlington, Mass. In Seattle in 1942 he met Joyce Marion Hinds, of Los Angeles, who gave up a career on the stage to marry him. They have two children, Diana Joyce and John Robert.





GIANT SHIP PROPELLERS MILLED BY ELECTRICALLY CONTROLLED CUTTERS

It is no longer necessary to hand-chip, grind, and polish the giant propellers that push our mighty warships and big cargo carriers. A sensitive electrical tracer mechanism can now feel the contours of a model smaller in any ratio between 2 and 5 to 1 and sculpture its exact likeness by directing two huge rams equipped with cutters (above, left). Developed by the Morton

Manufacturing Company and the Westing-house Electric Corporation, the machine has been in operation for two years, boosting production of propellers and making them more accurately than ever. The big blades on the right—of manganese bronze, 22 feet in diameter and weighing 60,000 pounds—form one of the largest "props" ever cast in the U.S.

ELECTRONIC SOUND DEVICE HELPS BLIND WORKERS DO PRECISION GAUGING

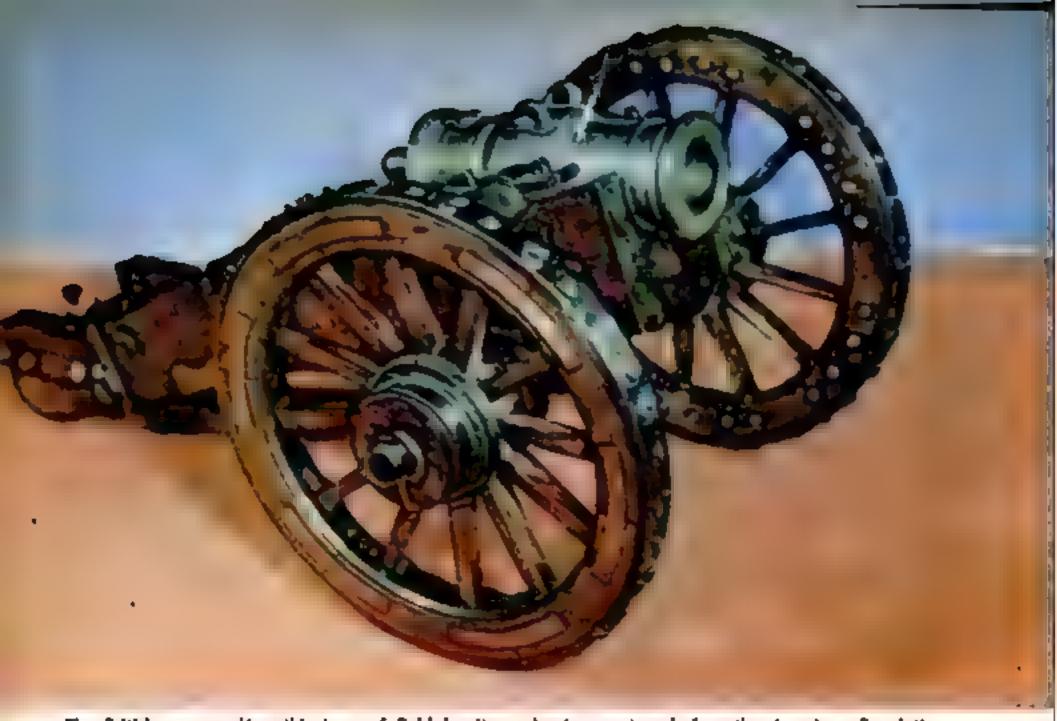
THE totally blind can now operate a gauging machine at the Timken Roller Bearing Company's plants at a speed comparable

with that of a person with perfect eyesight.

And this is final-inspection, precision gauging of rolls, cones, and cups, the components



of roller bearings. Timken's engineers have equipped their standard outside diameter gauge with an electronic sound device connected to a speaker mounted on the operator's chair. If the work piece is oversize, a high note is sounded; a low note indicates it is undersize. A tone between the two tells the operator the part is within the size limit.



The British were making this type of field havitzer about a century before the American Revolution.

ANCIENT EIGHT-INCH HOWITZER

Explosives were discovered around the middle of the thirteenth century; maybe Roger Bacon was responsible. Guns were used during the first quarter of the four-teenth century. So the field howitzer model illustrated in these pages represents about 800 years of progress from scratch in the manufacture of ordnance. We've gone much further in the last three centuries. This original cannon was built by the English in the late 1600's or the early 1700's, approximately a century before the American Revolution.

The model, which was made in England between 1825 and 1830, is in the collection of Charles B. King, Larchmont, N. Y. It is constructed to scale from materials as close to the original as possible—the cannon of brass and the carriage of heavy, reinforced, metal-bound wood.

The over-all length of the model is 17 % inches, and the bar-

With the trunnion clamps lifted, the original howitzer could be swung from its carriage by the loops.

rel length is 7% inches including the cascabel, that semispherical knob at the rear end. The outside diameter at the muzzle is

24 inches, while the bore is 1% inches. The outside wheel diameter is 9% inches, and

the entire length of the axle is 131/4 inches.

model was taken was smooth-bored, of

course. It lobbed a cast-iron ball eight

inches in diameter, but the projectile didn't

go very far, and it had a low striking ve-

locity, probably not very much greater than

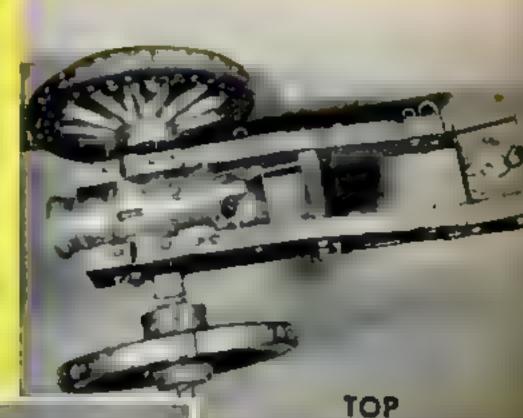
The original howitzer from which the

Photographs by ROBERT F. SMITH

that of a similar-sized bowling ball hurled down the alley by an expert. No doubt, however, it was as good as, or better than, anything the enemy could come back with in those days. Other early cannon of much greater size included the famous Dulle Griete, a 25-inch caliber gun built at Ghant in the latter years of the fourteenth century.

The howitzer working-scale model illustrated here is only one item in the King collection, which, as a whole, stands as one of the finest privately owned groups of models in the world. DON'T THESE PICTURES MAKE
YOU MODEL MAKERS' FINGERS
ITCH TO GET AT A SIMILAR
PROJECT! THE IMPORTANT DIMENSIONS ARE GIVEN FOR
YOUR GUIDANCE.





This model of a 300-yearold English howitzer reproduces all of the details and proportions of the original cannon. Built over a century ago, it is now in the collection of Charles

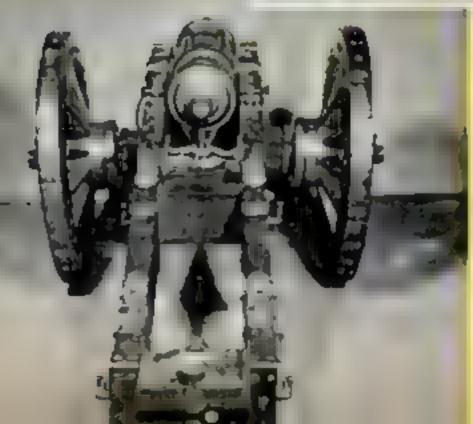
B. King, Larchmont, N. Y.

STIDE

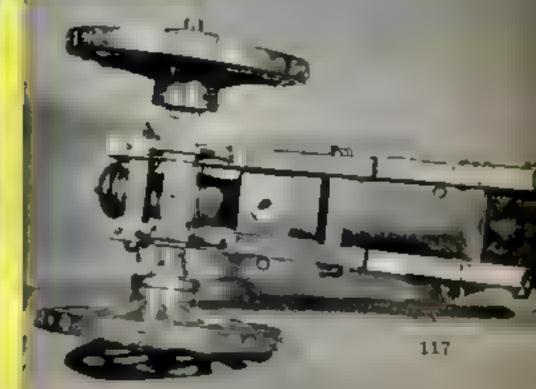
FRONT From the second of the s

From five various angles this stubby piece of artillery is of equal interest for its precision in workmarship and its sturdy construction. Notice the camber, or autward pitch, of the metal-tired wheels.









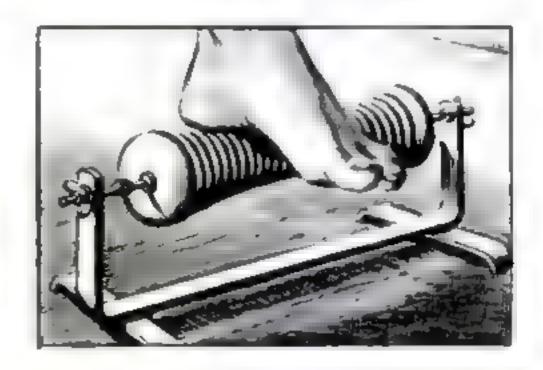
new, ideas from ?

YOU WRITE WITH LIGHT when you use this new pencil invented by Isabel T. Jansen, of Milwaukee, Wis., for marking sensitized surfaces of photographic films and plates. A needle-thin beam of light shines through a narrow Lucite rod that projects beyond the lower end of the barrel and is tapered like a pencil point. The light beam can escape only through a tiny window at the tip, giving a clean, fine line. A battery fits into the top half of the pencil, providing the power to light the bulb. Pressure on the point

the bulb. Pressure on the point forces the bulb upward so that its contact touches the battery pole, sending the light beam through the small window onto the sensitized surface to be marked; as the pressure goes off the light goes out.

MASSAGING THE FEET is easy with this flexible roller. It consists of a helical spring, smaller in diameter at the center than at the ends, encased in a ribbed cover and mounted on a ball-bearing assembly so that it turns freely in a metal frame. Ends of the roller are attached to the frame by clevises and threaded shanks, the latter making it possible to adjust the tension with thumbscraws. The inventor, Thomas A. Dolan, of Chicago, says that the use of the massager improves blood circulation and tones the nervous system.

LIGHT BULB



OPAQUE WITH

OPEN END

by C. F. Glinecki, of Syracuse, N. Y., provides everything except the talent. Folded for carrying, it makes a sturdy case with a suitcase-handle grip. Opened for use, it stands on four rubberfooted legs, which give it stability on a hard or grassy surface. The carry handle pulls out a drawer that is roomy enough to hold

many of the artist's supplies in a convenient spot as he straddles the seat. The support of the kit's detachable easel fits into a hole at the front end of the drawer, and the easel frame can be raised or lowered to suit the artist's convenience.

POPULAR SCIENCE



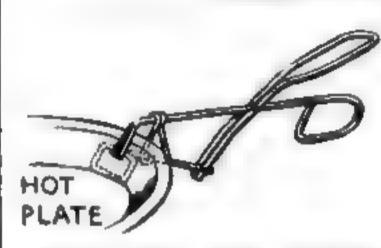
LUCITE

ROD

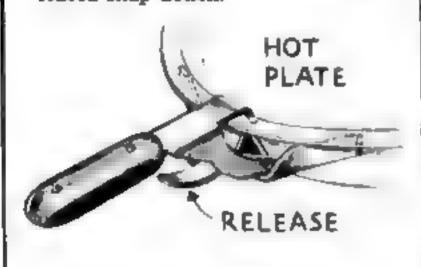
the inventors

"CANNING" FOODS in flexible plastic bags instead of the conventional tin or glass containers is the idea of Harry F. Waters, of New York City. The fruit or vegetable to be preserved-cooked or partially cooked - is poured into the bag. Then the top is closed and sealed tightly while hot vapor is still rising from it. When the contents have cooled, the vapor condenses and the top of the bag collapses upon the upper surface of the food. A hermetically scaled, sterile package substantially free from air is thus obtained. Food can also be cooked and sterilized in the bag. As an added protection in storage or marketing, the plastic bag is encased in a container made of fiberboard.





DON'T BURN YOUR FINGERS! Two inventors have tackled the problem of handling hot plates or pans. S. D. Duniap, of Bowling Green, Ohio, comes up with the tongs shown above. When the two arms are squeezed together, the plate is gripped securely between the curved end of one arm and a rectangular loop on the other. The lifter below, devised by H. H. Bakken, of Pueblo, Colo., grips the plate or dish with an easily released snap action.



BACON AND EGGS and toast are made ready simultaneously in the electric combination toaster and cooker below, invented by Daniel Platkin, of Los Angeles. The toasting section consists of two sloping surfaces with the heating element between them as in the ordinary electric toaster. In the base of the equipment is a sliding tray with heating coils above and below it. Bacon, eggs, chops, or small steaks are placed in the tray and cooked by merely switching on the electric current. The heating elements work independently; if you like your steak broiled, you use the one over the tray.





Seagoing Navy Yard Follows the Fleet

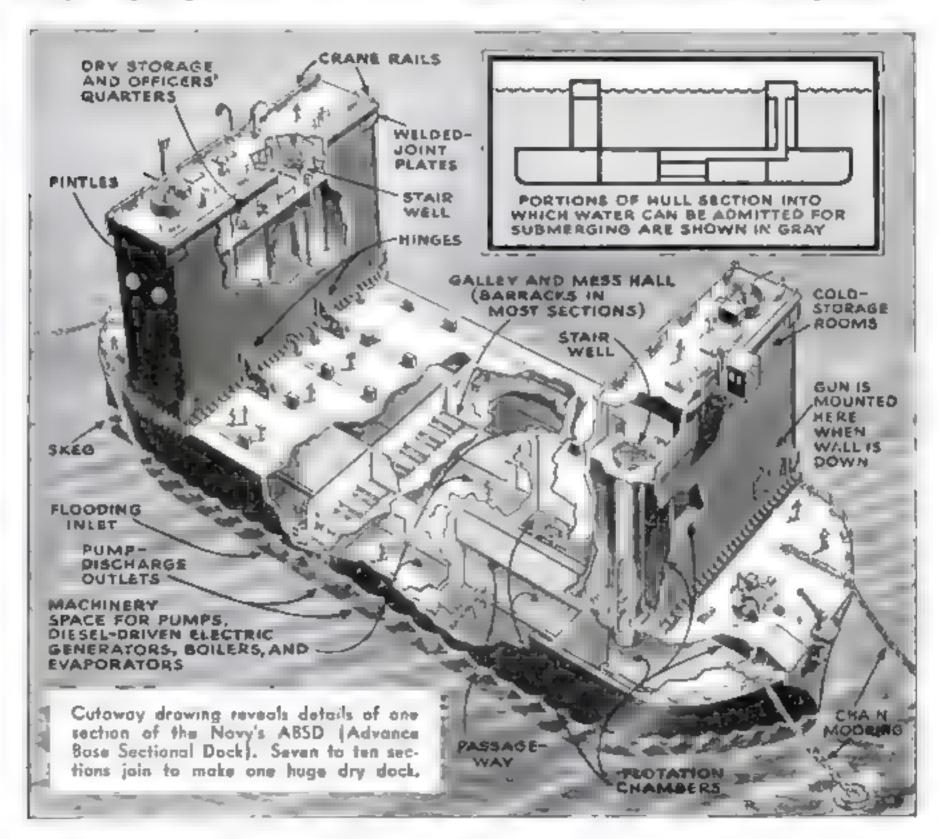
GIANT DRY DOCK MOVES IN SEPARATE SECTIONS TO ANY PART OF THE WORLD; ASSEMBLED, IT HANDLES ANY SHIP AFLOAT

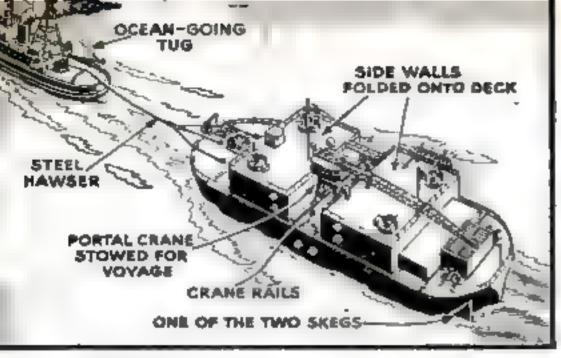
By CAPT. W. MACK ANGAS, (CEC) USN

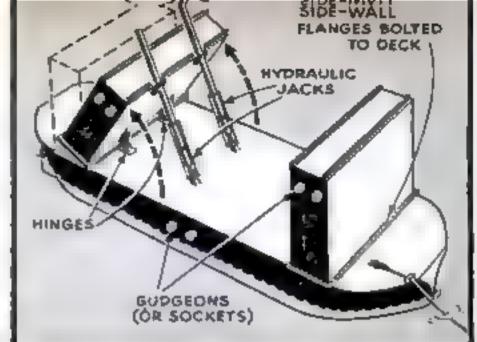
Drawings by STEWART ROUSE

ANYWHERE in the seven seas, gigantic floating dry docks take aboard the mightiest battleships and aircraft carriers of the United States Navy, and raise them high and dry. When battle damage has been repaired, the big men-of-war are returned to their natural element, fit and ready to fight again.

Having such a dock right with the fleet when you want it fulfills an admiral's dream. Superdreadnoughts, in advance combat areas, thus are spared voyages of thousands of miles to permanent repair bases at Hawaii and on the U.S. coasts. The difference in time that the ship is out of service may determine whether or not it can take part in a decisive battle, and its timely arrival could add the needed power for victory. In fact, mobile "hospitals" for







ASSEMBLY. Sections of an ABSD are towed separately by tug or Liberty ship, moving close to a combat zone. Two sections carry the dock's electric crones.

Anchored at its base of operation, a section raises its side walls by hydraulic jacking gear. Walls are then bolted down to the bed plates.

battleships seem likely to have a profound effect upon naval tactics of the future—a study that no nation dares neglect, no matter how remote the prospect of war.

First news that super dry docks were actually completed, and operating with the fleet, electrified naval observers many months ago. Now that World War II has ended, the Navy has released photographs and a full description of these extraordinary structures.

Too big to be towed safely across an ocean in one piece, the huge dock travels in separate sections—from seven to 10—each built upon a boat-shaped built. Hinged pieces, which form the side walls of the finished dock when elevated, are kept folded in transit to reduce wind resistance and lower the center of gravity.

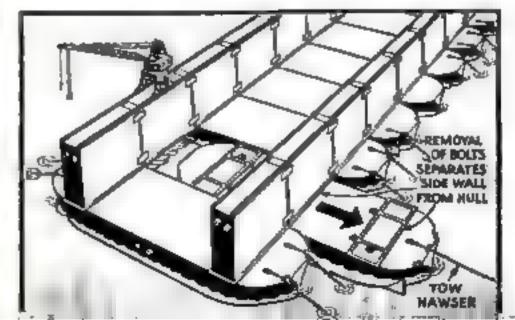
The individual dock sections, when prepared for towing, are self-contained seagoing barges, complete with crew's quarters, gailey, mess hall, steam-heating system, evaporators for making fresh water, Dieseldriven alternating-current generators, coldstorage plant, forced ventilation, anchor winch, and antiaircraft guns. Two electric cranea that subsequently operate on tracks along the tops of the dock side walls are, during the overseas voyage, carried on rails laid on the main decks of two of the sections between the lowered side walls.

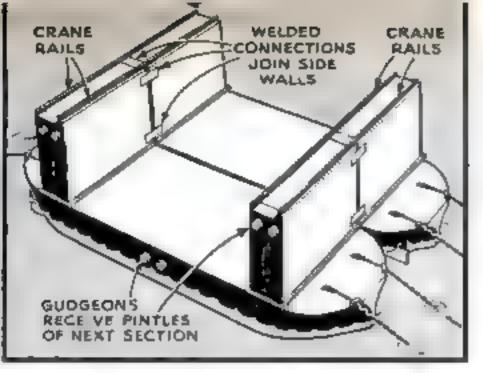
Upon arrival at the base where the dock is to be used, the sections are temporarily moored by their light bow anchors. The side walls are then raised by means of hydraulic jacking gear and bolted to bed plates provided on the forward and after deck of each section, a gasket being used in the joint to allow for slight irregularities in the metal. The raising of the side walls involves the disconnection of the engines and boilers from temporary exhaust lines and stacks, which led straight up through the lowered side walls, and their connection to permanent exhaust pipes and stacks terminating at the tops of the raised side walls. It also involves the rearrangement of officers' quarters and storage spaces in the side walls, as some of the floors of these spaces become walls, and vice versa, when the side walls are raised.

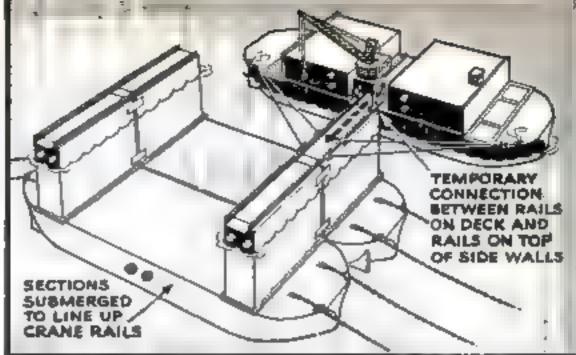
When the side walls of two sections have been raised, the work of connecting them is

DRY DOCKS REPAIR OWN DAMAGED SECTIONS

A section of an ABSD, with wing walls in place and towing tug alongside, is dry-docked in a partially assembled dack for repair before being fitted into its place (left). If a hull section of a completed dock needs repair, it may be unbolted and withdrawn.



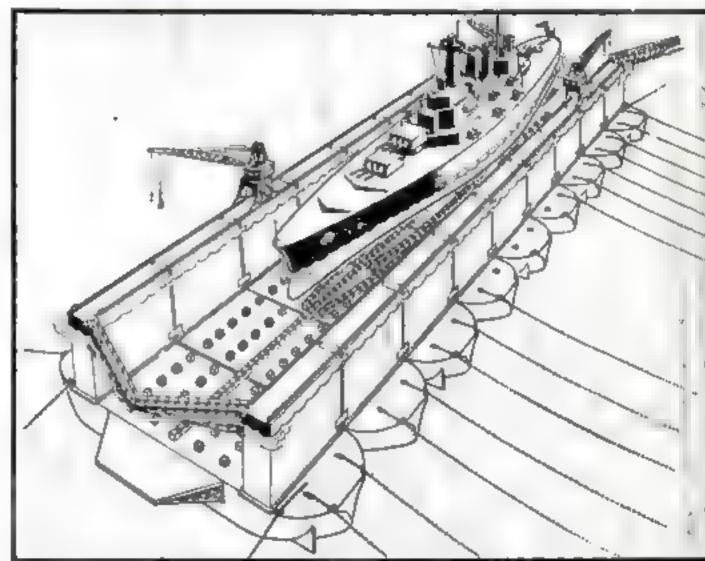




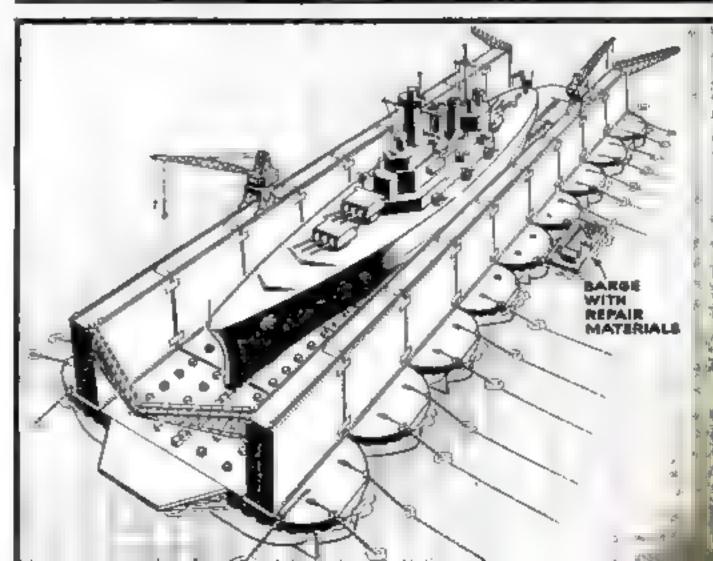
Sections are hold in line by pintles that fit into gudgeons of adjoining sections. Steel plates connecting walls are balted, then welded on.

After two sections are united, crones are moved into place on side walls. Joined sections submerge to level of crane-corrying section's deck, and crone wheels on.

THE SHIP ENTERS, All sections securely joined together, the assembled dock is moored with heavy anchors and chains and is capable of raising the largest battleships and aircraft carriers. Blacks are set on the decks of the sections to fit the contours of the keel and bottom of a fighting monof-war, and then the buoyancy chambers are flooded to lower the entire dock in order that the ship may enter. A 10section dock has a capacity of 100,000 tons. Often two ships at a time were repaired and returned to duty at Pacific bases. In one eight-month peried these floating docks handied 176 vessels of all types.



READY FOR WORK. buoyancy chambers are pumped out and the superdreadnought "site" high on a floating dry dack thousands of miles from established bases at Mawaii and the coasts of the United States. These ABSD's have all facilities and equipment necessary to save battle-damaged warships and to keep others at the peak of their fighting trim, The crones move heavy weights about the ships with ease. The hinged walkways at the forward end of the dock facilitate contering a ship as she enters, Walkways also speed possage from one wall to the other by workmen. Floating dry docks are a common sight at far-aff bases in South Pacific atolls.



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commenced by lasning the sections together with the projecting pintles of one section securely seated in matching sockets, or gudgeons, of the other to hold the sections in line. The lashings holding the sections together are then supplemented by cable linkages tightened by hydraulic jacks. Heavy steel plates connecting the upper and lower parts of the adjacent sections of the side walls are then bolted into place. The connections, after being bolted, are electrically welded, the strength of the completed connections being dependent solely on the welds. The side walls only of the sections, and not the hulls, are thus connected by welding.

After two or more sections of the dock have been connected the two big electric cranes are transferred from the main decks of the sections on which they made their ocean voyage to the tracks provided for them on the tops of the raised side walls of the connected sections. The buoyancy chambers of the connected sections are flooded until the tops of their side walls are level with the main decks of the sections carrying the cranes. Temporary connection of the sections and rails, as illustrated in the drawing in the upper right-hand corner of page 123, makes possible the transfer of the cranes. Additional sections are then connected until all are assembled into a rigid, floating dry dock capable of lifting the largest battleships and aircraft carriers. The assembled dock is moored by heavy anchors and chains.

A ship is lifted by first setting blocking on the main deck of the dock to fit the keel and bottom of the ship. The dock is then lowered by flooding the buoyancy chambers until only the tops of the side-wall sections protrude from the water. Now the ship enters the dock and is centered over the blocking Finally, the water is pumped from the buoyancy chambers, causing the dock to float and raise the ship with it.

If a hull section of the dock requires repair, it can be withdrawn from the assembly without cutting the side-wall welds, as shown on page 122, and can then be itself dry-docked for repair in the remaining sections, thus making the dock completely "self-docking." To pull a section out of place, the pintles and gudgeons are removed from it and from the adjacent sections. The buoyancy chambers of the free section are then partially flooded to lower the unit so it can be eased out. The welded joints of the side walls are strong enough to permit the operation of the dry-dock cranes over the missing section.

To move the dock from one base to another, it is disassembled by cutting the welds. The side walls are lowered, and the sections are towed forward and reassembled at the new base.

The development and design of these docks by F. R. Harris, Inc., consulting engineers of New York City, was under the direction of the Bureau of Yards and Docks of the Navy Department. Their construction has materially strengthened the Pacific Fleet, not by increasing the total number of ships but by increasing the number of "ships that count"—the ships available to fight where and when fighting is to be done.



QUARTERS.
This room is the officers' quarters aboard an ABSD.
When the walls of a section are raised or lowered, two of the walls become the floor and ceiling, and what were the floor and ceiling become the walls.
Storage rooms also must be rearranged.

"Picket-Fence" Brakes Slow Down New P-61 Black Widow



Novel wing brakes are an addition to the latest Black Widow P-61 night fighter. Designed to prevent the plane from overrunning enemy aircraft when attacking, the brakes are reinforced metal grids that open vertically to top and bottom wing surfaces about midway on the wing chord. They are counterhinged and counteracting to reduce operating pressures. When fully extended, the brakes provide a slowing force about equivalent to the normal weight of the night fighter.

Here's a Record You Can't Break

Nonereacher phonograph records of vinylresin plastic have now been made available for
home use by RCA Victor, Camden, N. J., after 11
years of research. The records, which are lighter
in weight than the usual kind, can be bent or
dropped without breaking, cracking, or suffering
in playing quality. They can be used on practically all home phonographs, and with various types
of needles. Fidelity of reproduction is enhanced
through lessened surface sound. First issues will
be restricted to newly recorded musical works,
and the manufacture of standard shellac records
will be continued.



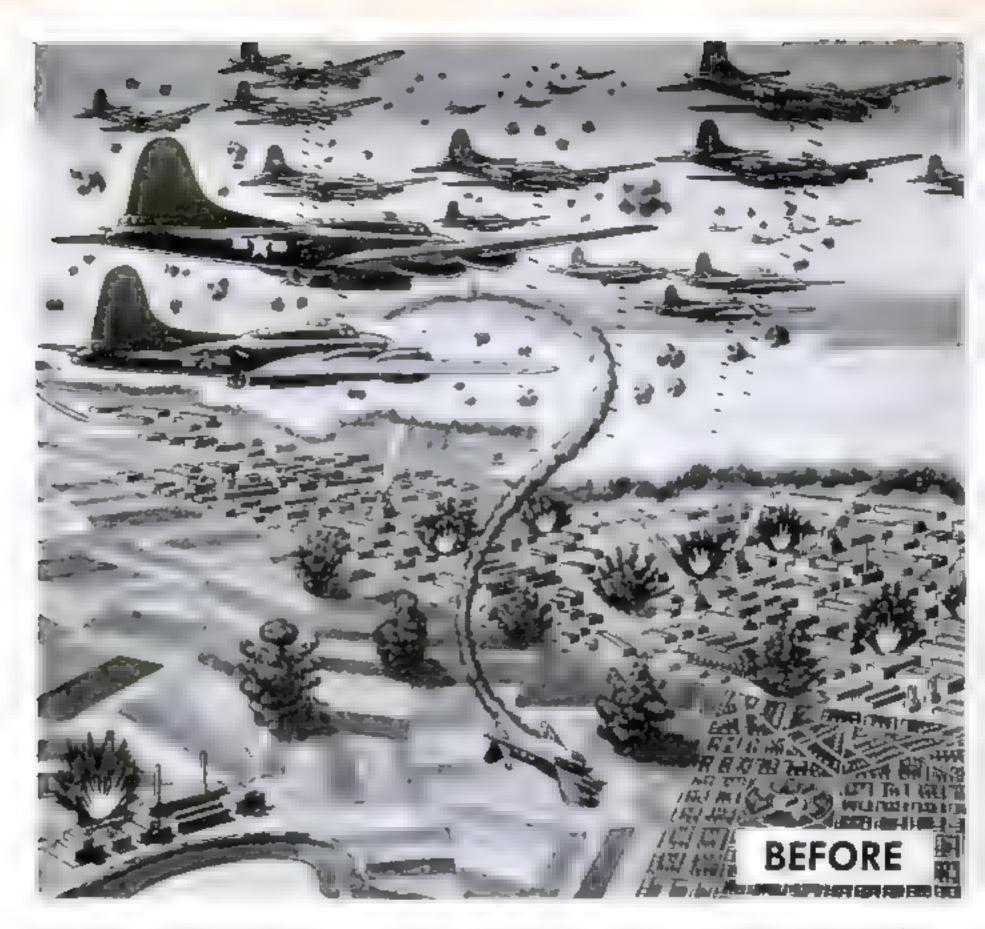
Timing Machine Helps Golfers to Develop Correct Swing

THE girl in the pictures below is practicing with a device, invented by Dave Bauer, Long Beach, Calif., that is intended to show up and correct faulty swings. The box tee on which she stands hides an arrangement of levers that connect a plunger under the

player's right beel with the tee on which the ball rests. If the heel is lifted before the ball is struck, the ball sinks, and the player "tops" it. When the ball is struck, another ball is rolled onto the tee from an automatic feeder.







This is how Leuna cotted when the AAF and RAF started, their systematic destruction of the sprawling. German industral city. Clevery planned and hotely defended, this part was as hard to kell as a cat.





As a smoke screen spreads across the plant, FW-190 fighters rise to challenge the bambers, to be met by escarting Thunderbalts. Photo at bottom of apposite page shows wreckage after nine perial knockauts.

The Nine Lives of Leuna

IT TOOK 6,630 BOMBER SORTIES AND OVER 85,000 BOMBS TO PUT THIS NAZI WAR-CHEMICAL PLANT OUT OF BUSINESS

By VOLTA TORREY

OR ten months, American and British airmen fought to deprive Hitler of the output of about three square miles of land deep in Germany—the site of one of the most productive, versatile, and formidable war plants ever built. This plant at Leuna, 23 miles east of Leipzig, was a gigantic monument to German chemical wizardry. Knocking it out was like killing a cat; it

had to be done nine times to make it stick. Repeatedly. American newspapers reported that hundreds of planes were attacking this target—all told, 6,630 bombers took off to destroy Leuna—but the whole story of this historic battle could not be told while it was being fought. Much more of the story of this enormous factory's battle with the bombers can be read now in the records of German home-front war lords and in the ruins of the plant. (Continued)

Leuna was originally a fertilizer factory, but the Nazis expanded her into an arsenal such as the world had never seen before. She became the second largest source of the Germans' synthetic fuel, and also their second largest chemical works. She produced tremendous quantities of scores of different necessities of war, including gasoline for the Luftwaffe, lubricants for the Tiger tanks, raw materials for synthetic rubber, and acids for explosives. She was suspected, too, of producing materials used by German scientists in their efforts to perfect an atomic bomb.

She made all these things, furthermore, mainly from coal, air, and water. Millions of tons of low-grade coal were scraped off the earth near by, and billions of gallons of water flowed into Leuna from huge waterworks less than a mile away. Hundreds of miles of underground cables, overhead piping, streets, sewers, and railroad tracks wove her 250 buildings together, and about 25,000 Germans and 10,000 slave laborers, skillfully guided by a few hundred chemists and engineers, were employed in this two-mile-long maze of machines and tanks.

Leuna's products were so numerous and various that the I. G. Farbenindustrie, which owned and operated this industrial monster, did not attempt to measure her production in tons, cubic yards, or money. Instead, the technicians judged her activity

by simply taking her pulse. This was done by counting the revolutions made per minute by the plant's scores of compressors. This figure was a fair indication of Leuna's productivity, because nearly all of her work required the use of gases—hydrogen, nitrogen, and carbon monoxide.

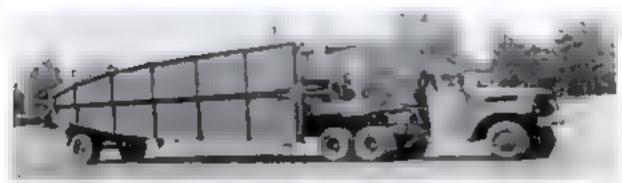
Leuna consisted of machines to produce and purify these gases, apparatus in which they could be synthesized, and the equipment needed to finish the various products obtained by bringing gases together. The gas-producing units were similar, so they were interchangeable; the synthesizing techniques were similar, so much of the apparatus in this category could also be adapted to various purposes; and Leuna had plenty of spare equipment such was used to finish each of her most important products.

These facts are pertinent to the story of her nine-round bout with the bombers, because they explain Leuna's astonishing ability to recover from aerial attacks. She was a man-made creature with a set of interchangeable hearts. Hence, there was no single, obvious place in which she could be fatally wounded. If one part of the plant was destroyed, some other part usually could do its kind of work, And, if the machinery needed for one kind of war production was destroyed, the remaining facilities could be used to manufacture something else. (Continued on page 207)

One of the 150 anticircraft guns that ringed the key Nazi war plant. Part of a 12-gun battery, it was a half mile autside the city. Allied airmen reported heavier flak over Leuna than above Berlin itself.







Eighty-foot, self-launching scissors bridges like this one would have carried the Yonks across the hundreds of streams in Japan. Set up in 15 to 30 minutes by six men, it consupport a medium tank—or another bridge on its carrier.

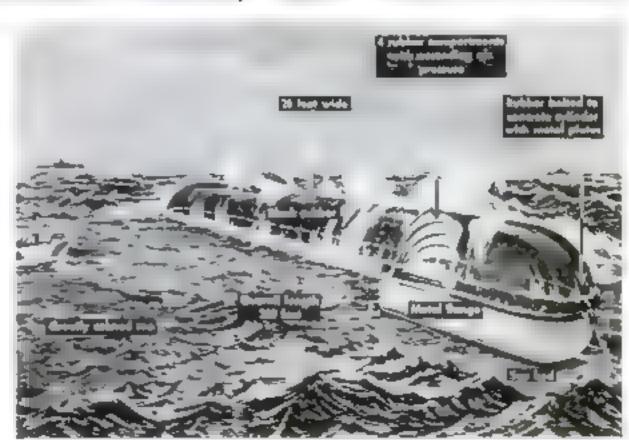
Army's 80-Foot Scissors Bridge Launched from a Semitrailer

AN 80-FOOT, mobile, self-launching sciasors bridge, developed by Army Engineers, was going into rapid production for use on the Jap home islands when the war ended. Made of aluminum-plate girders and weighing 13 tons, the bridge is transported by and launched from a semitrailer hauled by

a six-ton truck tractor. Winches and hydraulic rams powered by a 45-horsepower gasoline engine raise and unfold the span and later pick it up. The semitrailer also has a hydraulic rear steer, which permits turning within a radius of 55 feet and makes backing into launching position easier.

Giant Pontons, Anchored Offshore, Calm Waves on Beach

SCOTHER of the seas is this pneumatic wave controller which cuts down six-foot billows to approximately one foot. Pressurized chambers absorb the punch of heavy seas when units are set in line broadside to the waves, as shown in the drawing by E. G. Lambert, of the London Sphere. The 11-ton pontons, bolted to 700-ton concrete keels which were anchored to the sea bed, calmed the waves for Allied invaders in Normandy and may soon be bringing new safety to bathing beaches.



NOVEMBER, 1945

COURT TENNIS

IT IS STILL PLAYED UNDER THE VERY SAME OLD RULES



RACKET for court tennis, here held by professional world's champion Pierre Etchebaster, has a smaller head than that used in lawn tennis. Early players of the game employed the palm of the hand.

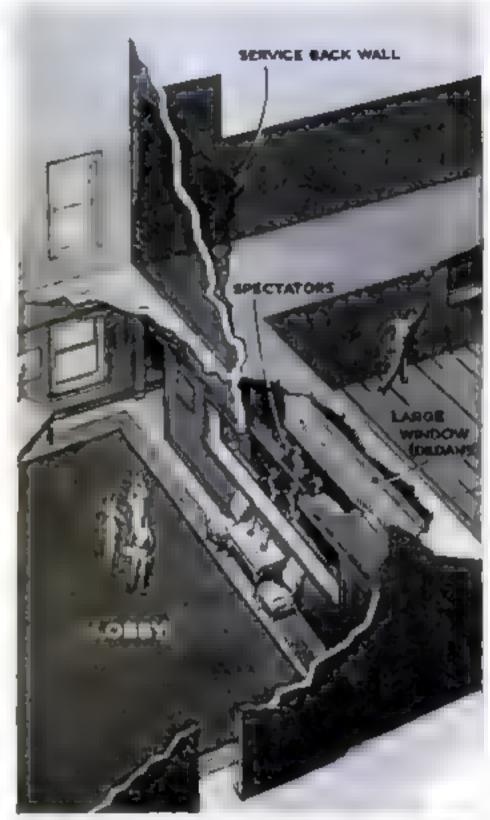
COURT is patterned after the courtyard of a medieval castle and measures 30 by 90 feet. It costs about as much to build as a swimming pool. There are only a few such courts in this country.

By VOLTA TORREY

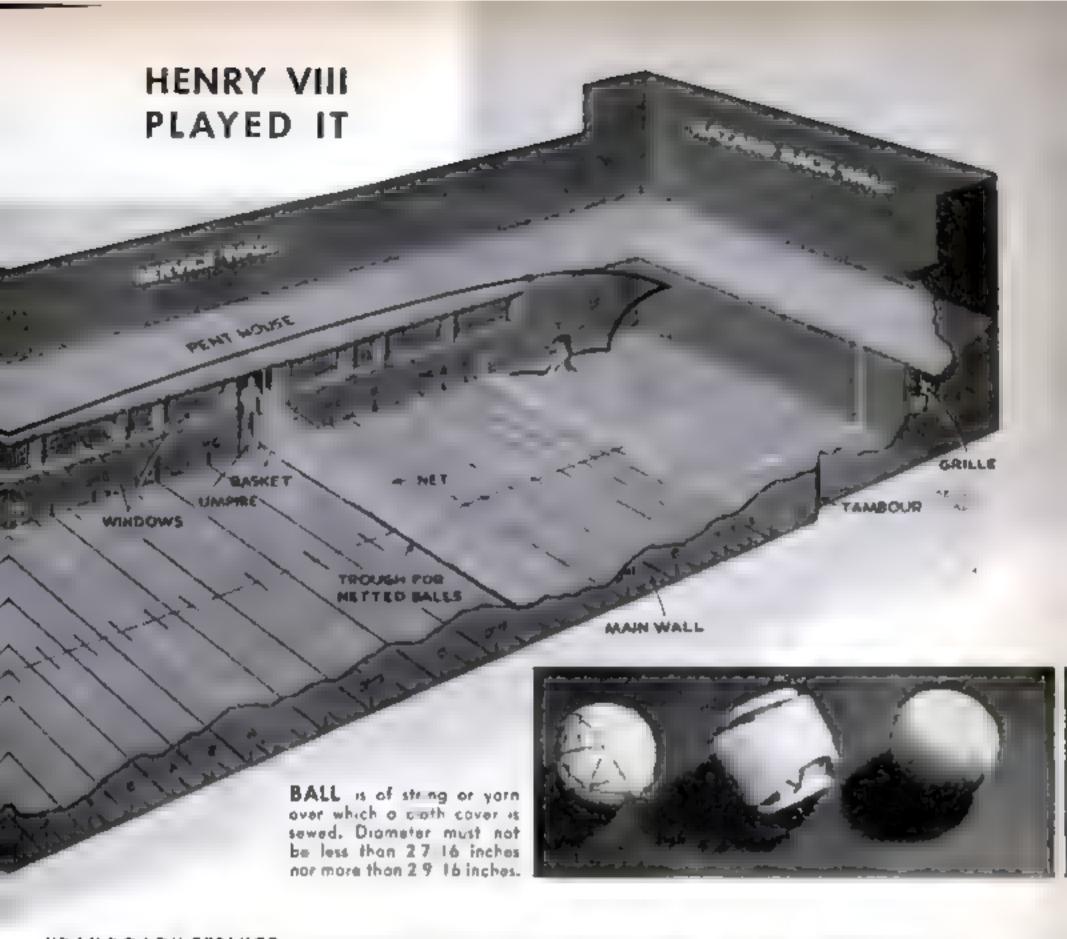
Photographs by WILLIAM W. MORRIS and ROBERT F. SMITH

AT THE Racquet and Tennis Club on New York's Park Avenue, tennis is still played the original way—and to see it done is as bewildering at first as watching a chess game when you know only checkers rules.

A short, sloping roof, a little higher than a man's head, protrudes into the enclosed court from each of three walls. Beneath this porchlike roofing, there are windows of various sizes into which the ball is frequently driven, sometimes accidentally and sometimes deliberately. In the wall along the other side of the court, there's an upright jog, which often causes the ball to ricochet crazity. (Continued)





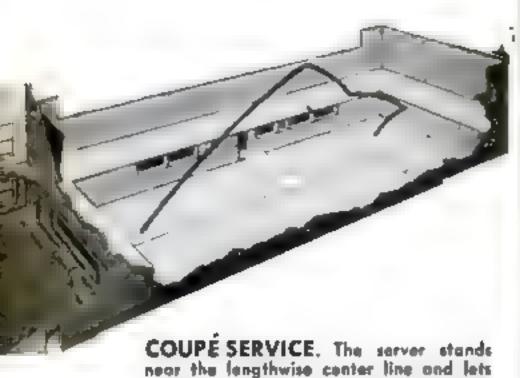


"RAILROAD" SERVICE is demonstrated by Etchebaster in the photographs below. Standing ready (1) about four yards from the rear wall of the court on the gailery side, he tosses the ball into the air (2) and steps forward (3) as he strikes it with the sacket. When he finishes the strake (4) he is on the five-yard me. Ball skims above the penthouse roof and bounces off it beyond the net, as illustrated in the drawing of the court.









COUPE SERVICE. The server stands near the lengthwise center line and lets go from about two yards in front of the dedans, or spectators' gallery. This time he does not toss the ball nearly so high (1). He strikes it close to the floor, but twists the racket (2) enough to lift the ball anto the penthouse roof. The spin given the ball causes it to come off the penthouse at an angle, and the power of the service sends it close to the rear wall at the apposite (hazord) and of court.

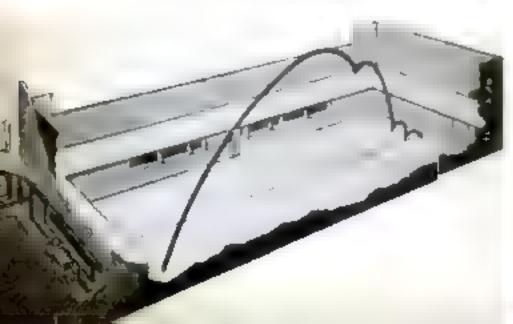
The net across this court is five feet high, with a sag of two feet in the middle. The rackets with which the ball is batted around have small, lopsided heads. And the ball looks like those used for lawn tennis, but it is heavier and behaves more like a base-ball.

A good player can make this ball curve, drop, and bounce swiftly or slowly; by taking advantage of the odd architectural arrangements of the court he can cause it to burtle toward his opponent from any direction, including the rear.

A court like this, resembling the courtyard of a medieval castle, now costs as much as a swimming pool. There are only a few such courts in the United States, and only a few dozen in the whole world. But 345 years ago there were hundreds of them in Paris, London, and other sophisticated cities, and the sporting gentry bet scandalous sums on the game.

Court tennis, as this strange sport is called to distinguish it from lawn tennis, was once so popular, in fact, that kings forbade common folk to play it. The rulers were afraid that the pastime would interfere so much with their subjects' archery practice that they'd lose the next war. The kings and their palace pals were too fond of the sport, however, to give it up themselves. So court tennis became "the game of kings." The men who play it nowadays insist that it is also "the king of games."

AJUSTE SERVICE. Standing near the wall apposite the galleries, about four yards from the rear of the service side of the court, the server tasses the ball about as high as his head [1], and strikes it (2 and 3) in such a way that it soars high over the net and lands on the penthouse roof. It then may fall close to the rear wall on the hazard side, with practically no bounce, which makes it difficult to return. The hazard side has little room in which to attack this fast service.









The score is kept and sets of games are played as in lawn tenns. But Shakespeare and Rabelais would feel right at home among the spectators at a 1945 game, bacause the lingo of the sport is almost the same as in their time.

The roofs, for example, are called pent houses, the jog in the wall on one side is a tambour; the windows along one side of the court represent doors and galleges; the little opening that looks like a jail window at one end is the arille; and the big bay window in the other end wall is the dedans (pronounced "dead-ans")

An official known as a murke stands at one end of the net to call the players' shots Spectators sit at one end of the court, instead of along the sides, and see the strange gangs-on through the dedans at the service end of the court. The far wall, toward which the ball is always served, is the hucard end. Lines painted on the floor guide the players—and the rules are as complex and curious as the arrangement and nomenclature of the court

The player who serves the ball must not only knock it over the net, but also cause it to touch the penthouse roof on his opponent saide of the net before it falls to the floor within a certain area. He gets two chances, and loses a point if he doesn't do the trick

After the ball has been served, it may be volleyed. But there's more than one way









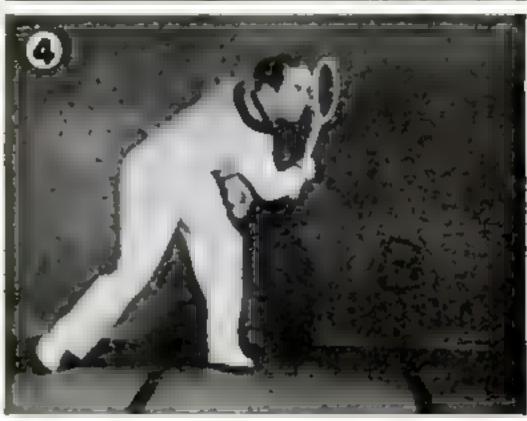
RETURN OFF PENTHOUSE. The player faces the hazard wall (1) waiting to get the ball on its rebound as it falls off the penthause roof. When this occurs, the player catches it on his racket and sends it back with the necessary lift on its way over the net at the center of the 90-foot court (2). Swift action, a good eye, and absolute control of the faculties, both mental and muscular, are necessary to carrying out this play.

RETURN OFF BACK WALL. Etchebaster's apparent then may try to score by driving the ball into the big window in the wall behind the server. If the champion sees the ball is going into the window, he swats it first with his racket (1). But, in this instance, he has seen that it is going to strike the back wall below and to one side of the window. So he has chosen to wait in the carner for it to bounce off the back wall. As it comes away from the wall, he gets his racket behind it (2), and delivers it swiftly back over the net to his apparent.













Now comes another test of the player's skill. With his racket very close to the floor, he must scoop the ball with precision and speed for the lift and propulsion over the net. He's ready (3) for this crucial play, and (4) he has finished the strake in a position that makes him able to face his apparent again and keep on playing. In court tennis, a player has to be prepared to meet a ball from any direction, including the rear.

of scoring. The player on the service side, for instance, may score by socking the ball into the grille, the little window in the wall behind his opponent, or by driving it into the farthest of the windows along the side of the court. And the player on the hazard side of the net can score by knocking the pellet into the dedans, the big slot in the wall behind the server.

Netting over the windows protects bystanders and makes it unnecessary to chase after the ball. Even so, a basket containing seven dozen spare balls is kept within reach of the server, so that the game need never be delayed.

Batting balls into the windows adds to the excitement. But it's also possible for a player to gain in this game by deliberately

adds to the beginner's befuddlement.

Suppose, for instance, that the ball goes into a nonscoring window, or lands in a corner or

refraining from returning a ball-and this

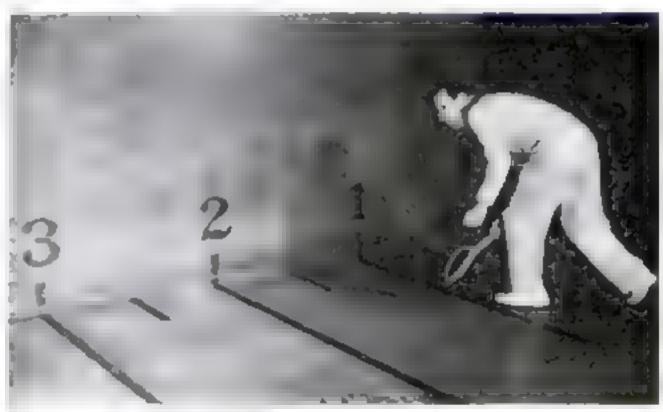
CHASE, As the game continues, it becomes more complicated. When a ball isn't returned by a player, the morker (or referee) calls a chase of a certain distance. After two chases have been made, the players change sides, and each chase is played off. Photograph at right shows

defense of two-yard chase.

in some other spot from which the player on the receiving end cannot return it, or doesn't feel like trying to return it. Instead of giving a point to the fellow who socked the ball, the marker calls a chase. But nobody chases anything. The marker just makes a mental note of what has happened and bides his time.

Pretty soon, the same sort of thing is likely to happen again. Then, when two chases have been called, the players change sides of the net, after which, before the game goes any further, each chase is played off. This seems silly, but it's fun when you understand it.

When a chase is being played off, the marker remembers where the ball went out of play. The man against whom the chase was made is ex- (Continued on page 206)



What's New in Modern Living

POKER-CHIP RACKS are now appearing in clear, sparkling vinyl plastic. The one shown below was designed by Tabor Metzler, of Los Angeles, and will hold 200 chips —50 blues, 50 reds, and 100 whites. Its eight compartments are designed to permit easy withdrawal of chips.



plunger arrangement that presses dough out of the cutter and into the pan. They will also cut bread and cheese for canapés.





TEMPERATURE MAKES TIME in this clock, which is self-wound every time the temperature changes. Gas in a scaled drum contracts and expands to activate a tiny believe that winds the spring. As little as a 1-deg. change winds the clock for 120 hours. It's made by Longine-Wittnauer.

PERMANENTS AT LUNCH TIME are possible with a new type of cold hair wave that can be completed from first washing to final drying in one hour. The new permanent has as its base a cream lotion and, according to Tylon Laboratories, of New York, results in a soft wave with no injurious effects or splitting of the hair. It is said to be long-lasting, and no cutting of the hair is necessary for its application.

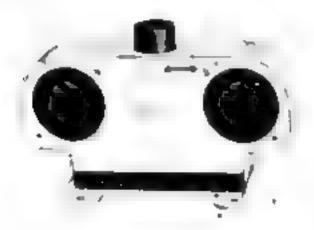




TRIGGER-ACTION GARAGE DOORS

are opened or closed by the car itself as it passes over a contact unit in the driveway, whether on the way into or out of the garage. The operating mechanism is housed in an overhead channel bar, as shown at right. A trigger release and two weights—one for opening and one for closing—are at the side. The rubber-covered contact box encloses a bearing bar that is depressed by the car and putts a trigger cable connected to the door release. Purdy Door-Operator Co., of New York, manufactures the control.





IWIN FLUORESCENT-LAMP SOCKETS are available in a new design that holds 40-watt lamps in firm electrical contact. They can be mounted on any flat surface with two screws. For connection, tinned and stripped leads can be inserted through entrance holes in the face, and binding screws can then be tightened up to make permanent, pressure contacts. The disks containing the holes for the lamp pins can be depressed by either end of a lamp that is being inserted or removed. The holder is a product of the General Electric Company.

TWO ELECTRIC HEATERS, one a self-contained steam radiator and the other a supplemental room-heating appliance, have made their appearance. The latter, known as the Trilmont Safety Heater, is shown at left below. This is a heater for taking chill

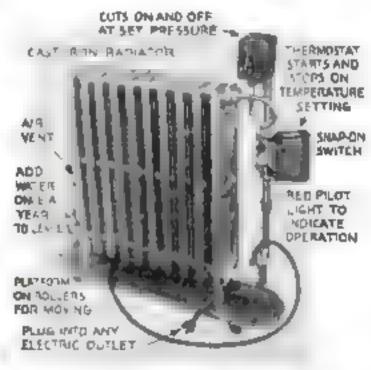
from a room or removing dampness when the main heating system is not in use. It was invented by David M. Trilling and George H. Rich, of Philadelphia.

The radiator at right is a main heat source. Water and antifreeze are put in by the manufacturer, and the radiator is ready for use when plugged into an outlet. A red light indicates it is in operation. An automatic cutoff acts at 2-lb.

Auxiliary heating is provided by the heater below, while the radiator is a main heat source. Both are electrical.



pressure, and current then goes on and off until the thermostat setting is reached. Radiators come in six, eight, ten-section, and larger sizes. Water need be added only once a year. The maker is the Home Owners Utilities Co., Inc., of New York.



GUS EXPLODES A MYTH

A FAMILIAR CAR STORY WINDS UP IN THE MODEL GARAGE

By Martin Bunn

man, garbed in flashy sports clothes, with that embarrassed feeling we all have when we know we've met someone sometime some place but can't remember where or when.

Then he laughed. Don Gordon, of course! Gus had seen him only a week earlier, but then Sergeant Gordon had just come back to town with five overseas bars on the sleeve of his O.D. blouse, a combat infantryman's badge, and a miniature rainbow of service ribbons on his breast. Clothes, Gus thought, do make a difference.

Don grinned and directed attention to his sporty scenery with a sweeping gesture.

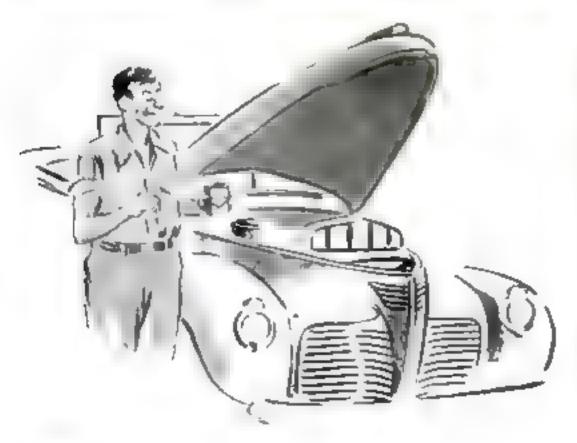
"Like 'em?" he asked. "Pretty nifty, hey? Mister, you're looking at a civilian—and am I glad!"

"First off," Gus chuckled, "I thought you were one of the minstrel men from that show they've got down at the Opera House. Well, you've earned the right to wear any kind of clothes you want to—even if they are sort of hard on the neighbors' eyes. . . . Get your car fixed up yet, Don?"

"Yes, sir," Don replied proudly. "It's like me—so darned shined up you won't know it. I've been working on it most of the time since I got home—painting, polishing, and one thing and another. That bus gleams, Mr. Wilson—just gleams!"

"That's all fine," Gus said with a wry

Painting the engine red certainly made it look a lot better.



smile. "But there's something that has always seemed to me to be almost as important as how a car looks—I mean, how it runs."

Don perched on Gua's workbench and pulled on a cigarette he was smoking.

"Well, now you mention it, I'm having a little trouble with how it runs," he admitted. "And that's one reason I'm here to see you. It showed up the first time last night. I met a cute number and took her out for a ride. When we were three or four miles out of town she thought she smelled something burning. I took a sniff, and it did smell that way. Then I looked at the heat indicator and saw the hand way over in the red.

"I thought I'd better stop, but when I pulled over to the side of the road to a nice dark spot, my date wouldn't have it. "You'd better keep on driving whether you and your jalopy burn up or not," she says. So I went on a little farther until we came to a roadside grill."

Gus laughed out loud. Don grinned sheepishly and went on: "We went in and had a sandwich. Stayed maybe an hour talking and playing the juke box. Then when we came out, the heat indicator was back where it belongs. But it was over in the red again before I got the girl friend home—and before I got home I had to stop for half an hour to let the engine cool off again."

Don paused a moment to light another

cigarette from the butt of the one that was almost consumed, and Gus waited patiently.

"First thing this morning," Don went on, exhaling a cloud of smoke, "I got busy on trouble-shooting. Ted Chambers helped me—he's a guy who moved in next door while I was away, and he knows his automobiles. We couldn't find a thing wrong—the radiator doesn't leak, and it wasn't dry or stopped up or anything like that. The fan belt wasn't loose, and the muffler wasn't clogged.

"Ted says that the overheating must be caused by carbon in the cylinders, or by the valve timing being off, or by the water pump. That stuff's too complicated for me, so I drove the bus over here. And the heat indicator is over in



the red on the temperature gauge again!"
"Drive it in," Gus invited.

A strong reck of scorched paint preceded Don's much-polished convertible into the Model Garage shop, so when Gus raised its hood be wasn't surprised to find the engine resplendent with a newly applied coat of fire-truck red paint.

"What artist did this job?" he asked.

"I did," Don said, self-satisfaction in his tone. "Ted Chambers came in while I was touching up a few little cracks and said I ought to paint the engine to keep it from rusting. It makes it look a lot better."

Gus grunted, and then examined the radiator. "I suppose it was Ted Chambers' idea to paint the radiator core red, too, wasn't it?" he demanded.

"Yes, it was," Don assented. "There was enough paint left after I'd finished the engine. Looks swell, doesn't it?"

"That's a matter of taste, I guess," Gus replied, lowering the hood.

"Aren't you going to look at the cylinders and those other things?" Don asked in a surprised voice.

"There's no need to look at anything else," Gus said, "That hot paint job is what's raising hob with your cooling system."

Don's mouth gaped. Then he laughed. "Quit kidding me, Mr. Wilson. How could paint have anything to do with the engine overheating? When you get a new car, its engine is painted, isn't it?"

"It is," Gus agreed. "But it's painted with a special kind of paint that doesn't lock in the heat. You didn't use that kind—just or hary paint that prevents proper dissipation of the heat by the metal of the engine. That was bad enough, but when you painted the radiator core you really hit the

jackpot. By doing that you retarded the cooling action of the fins to such a degree that they can't throw off the heat fast enough to keep the water from boiling."

"Well," Don gasped, "I'll be darned! A little thing like that to make all that trou-

ble! Why, Ted Chambers says—"

"If I were you," Gus told him grimly, "I'd forget what Ted Chambers says—or at least check with somebody who knows what he's talking about before you take Ted's advice. Now, I'll tell you what to do, Don. Go over to the hardware store and buy a can of paint remover. Then go to work on your radiator core and your engine, and get every bit of paint off them you possibly can. Don't forget to disconnect your battery before you start—paint remover is inflammable and any little spark might start a fire. When you've got rid of the paint, or as much of it as you can, you won't have any more trouble with the engine overheating."

▲ FEW days later Don reported that by hard work he had managed to get most of the paint off the radiator core and the engine and that his auto trouble seemed to be over.

During the next couple of months Gus saw him now and then when he stopped at the Model Garage for gas, and Don always boasted that his car was "running better than it did when it was new." Then came the first real cold night of winter, and among the numerous phone calls for belp next morning was one from Don Gordon.

"You'll have to send your wrecker up and tow my bus in," he moaned. "The engine block's cracked wide open. I can't understand how it happened, either. Why, Ted

Gus was having a hectic morning with S O S's over the phone just then, and he didn't care nor want to take time to hear what Ted Chambers had said, "I'll send the wrecker as soon as I can, Don," he promised, and bung up.

Late that afternoon Stan Hicks, the Model Garage's grease monkey, towed Don's convertible—still highly polished—into the shop. Don climbed out of the wrecker with

a face as long as his arm.

Chambers said—"

"Believe me, Mr. Wilson, this is a bad break," he said. "This job's going to cost plenty, but the worst of it is that I've got to have a car to get to work in. How soon can you fix it up?"

"Let's see what's the matter with it first." Gus said. He raised the hood, examined the engine block carefully, and shook his head. "I'm sorry, Don," he told him, "but there's only one answer-a new block. And getting one in a hurry isn't going to be easy either." He sniffed at the engine a couple of times. "Don't tell me you forgot to put in antifreeze:"

Don's face turned crimson. "Well," he admitted, "I didn't exactly forget, but I kept putting it off. I thought the engine was protected anyway."

"Protected?" Gus asked with a start.

"Protected against what?"

"Protected against the engine block cracking even if it did freeze," Don explained, "Protected by what?" Gus persisted.

"Why, by freeze-out plugs," Don told him. "My engine's got them,"

"Ted Chambers told you so, I suppose,"

Gus said.

"Yes, he did," Don confessed, "But I saw them myself. While I was getting that paint off the engine block a couple of months ago, I noticed several little round metal plugs just about the size of a quarter on the lower part of the block. Ted was around, and I asked him what they were for. He told me they were freeze-out plugs -that some manufacturers put them in engine blocks so that, if the engine did happen to freeze up, the pluge would pop out."

He reached under the hood and brought out a couple of round metal plugs. "See, here are two of them right here," he said eagerly. "They were popped out by the ice, just as Ted Chambers said they would be, but somehow they didn't keep the engine block from cracking."

"US shook his head sadly, "This Ted Chambers you're always quoting," he said, "where did he learn all this stuff he says he knows about automobiles?"

"Oh, I dunno—he took a course in some

college," Don replied.

"He'd better go back and take another course—and in a different college," Gue growled. "Either that, or stop passing out misinformation that gets people in trouble. Well, you're not the first car owner who has got well atung through believing that yarn about freeze-out plugs. A jot of people call them that, but they're really welch plugs, and their only purpose is to close up the holes made by the core-sand legs when the block was cast in the foundry. Sometimes they are forced out when the water inside an engine block freezes solid, but they never keep the block from cracking."

Don's face looked the way it must have when his division was smashing out of the Remagen bridgehead. "I'm going after Ted Chambers, and—"

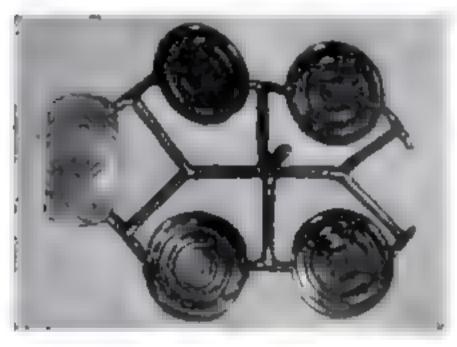
Gus laughed, "Take it easy," he advised good-naturedly. "A sap can't help being a sap-but you don, have to be another one by believing everything he says. You'll be getting a bargain if you learn that for what a new engine block costs!"

AUTO IDEAS



HOT-WATER TANKS salvaged from a dump have proved a satisfactory substitute for costly cable fence at a danger point where a street skirts a steep hill in Bridgeport, Conn. The 6' domestictype tanks were buried for about haif their length, filled with concrete, sealed, and painted white. Several cars have crashed into them, but all of the tanks still stand firm.—Charles Barr.

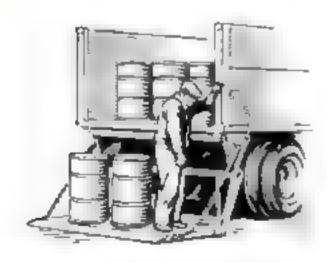
PLASTIC PEDAL PADS for automobiles are being produced at Bay City, Mich., by the Bay Manufacturing Division of the Electric Auto-Lite Company. Molded in various sizes from a rubberlike plastic, the new pads, shown in the photograph below, are designed to replace worn ones made of rubber. All are deeply ridged, providing a firm grip for the motorist's foot. They also are designed to fit securely over the bare steel of the pedal.

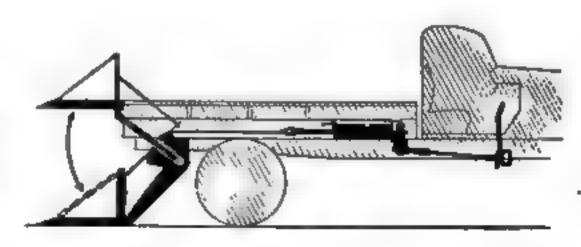


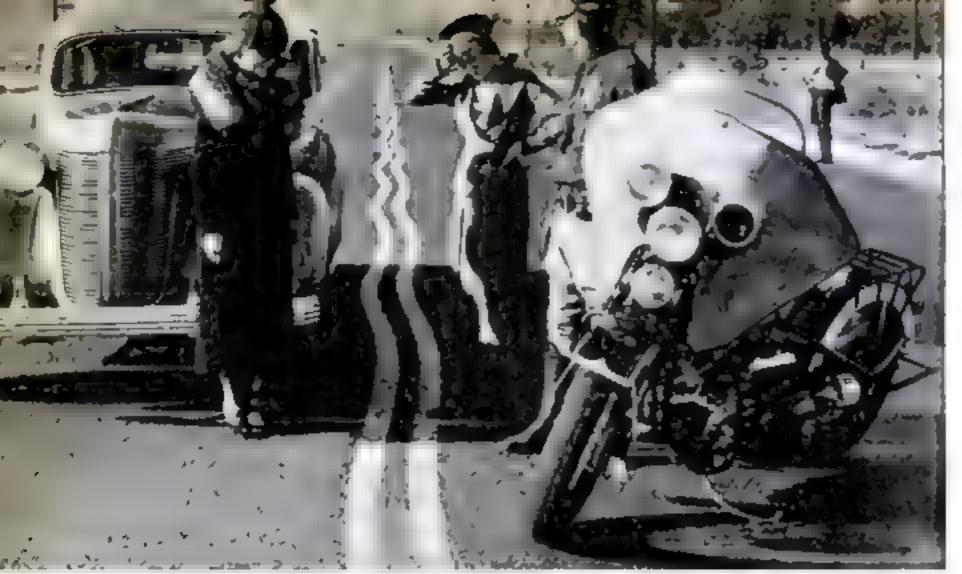
LOADING AND UNLOADING of trucks is achieved with greater case and speed by means of an elevating endgate now available from the Fruehauf Trailer Company, of Detroit, Mich., for installation in place of an ordinary tail gate. Hydraulically driven

CHECKING CIRCUITS ranging from 5 to 50 volts is simplified by the above tester, manufactured by the Ideal Commutator Dresser Company, of Sycamore, Ill. It not only detects open circuits and burned-out fuses, but can be used to indicate relative line voltages. Small enough to carry in a pocket, the tester is intended for automobile and aircraft mechanics, telephone repair men, and electricians. A transparent plastic housing protects the lamp.

by the truck engine, the steel gate serves as an elevator to raise or lower materials weighing as much as one ton. By its use, one man can handle objects normally requiring several persons. Operating levers are located at the rear of the vehicle.







Do these lines make you dizzy? They shouldn't; they're a San Fernando way of warning of a curve ahead.

Highways That Will Help You Drive

ACCESSORIES ARE MAKING ROADS AS MODERN AS YOUR NEW CAR

By Gilland Mason

OUR next new car may be the real dream boat you've always wanted, but even with nothing more than your present equipment, tomorrow's motoring will be a kind of travel you have never before experienced. Look to a new idea in highway engineering for the explanation of this coming turn in motoring. Highways are acquiring accessories—road gadgets that will mean to motor travel, and to you, just what they have meant to your automobile.

"In fact, we got the idea from looking over car catalogues," one highway engineer admitted. "Suddenly we became conscious that if you stripped a modern car of its accessories you would be left with something too basic for comfort, safety, and pleasure. We realized then and there that highways, even the most modern ones, had too little 'plus.' Actually the highway user has been getting only a bare chassis and the essentials. What we propose to give him now are the accessories—the highway features that

are as modern as his coming new car will be."

Fortunately there are some handy samples of highway gadgeting to show us how this is to be done. Drive up Connecticut's Merritt Parkway on a rainy night, and you'll be greatly aided by clear outlining of the highway shoulders by reflections from small bits of glass embedded in the concrete curbing. These are like the reflector lenses on your car taillights. Take another route where curves are a menace, and you'll find the idea of your car bumpers neatly transferred to the road shoulder. Special fencing of steel cable is designed to yield a little, but not break, should your car strike it.

Even the idea of the rear-view mirror has its counterpart on well-equipped highways. Maybe you have already seen it. Above the crest of a steep hill there is a piece of bridgework carrying a giant mirror. On your way up the hill you can see what's coming up the other side. It was designed to prevent head-on collisions at hilltops, but when all highways are made into one-way lanes, it will serve a different purpose. You

ARE DESIGNED FOR MOTORING SAFETY AND COMPOR

will then glance into the mirror on your way up to make sure the roadway is clear on the way down the other side. Traveling at 60 to 100 miles an hour, you'll want to know what the situation is beyond your line of vision so there won't be a chance of piling up should a car be wrecked or stalled beyond the crest.

Much has been written about the development of superhighways with special emphasis on safety and convenience. Now attention is focused also on improvement of existing roads with new gadgets. Taking a leaf from the car itself, highway engineers are blueprinting an amazing group of "extras" that are certain to change the whole complexion of motoring. What they are dreaming of makes still more interesting reading.

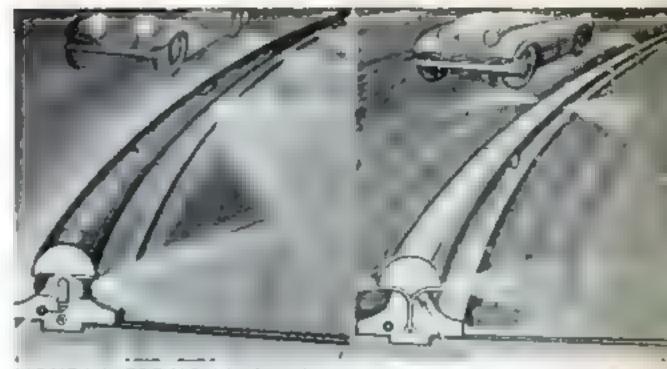
"What's this about traffic dividers?" I asked one highway expert who had his feet on the drawing board.

Instantly his feet were on the floor, his hands reaching into the files for a picture of America's first traffic divider which appeared on Chicago's Outer Drive. He pointed out the hydraulically controlled curbings that break up the 100' roadway into lanes to take care of traffic flow automatically.

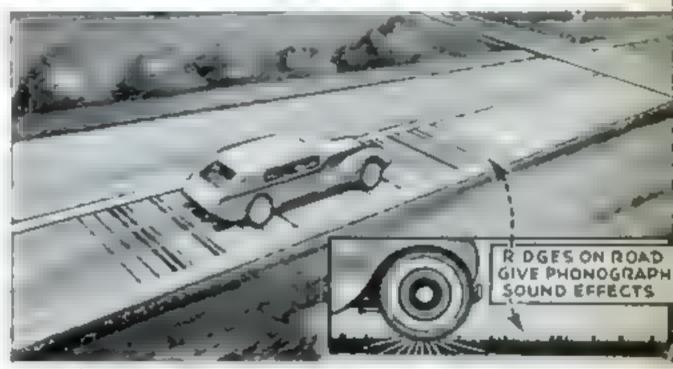
"This is just a hint," he explained, both feet still on the floor. "The carburetor on your car is controlled by a number of special devices, so what's wrong with controlling the width of traffic lanes? We can raise 600' of this curbing in 11½ seconds. When traffic is light, cars can roll along in 50' lanes, but when there is more need for regulation they can be confined to 25

lanes. In the morning, when most people are on their way to work, the dividers can be made to give the downtown lane 75' of width and cut the outbound lane to 25.

But I was more interested in what he was dreaming about when I caught him with his feet on the drawing board.



LIGHT WHERE YOU WANT IT and skidproofing are coming with land curbings. Temperature-sens tive devices may turn on chemical thawing sprays



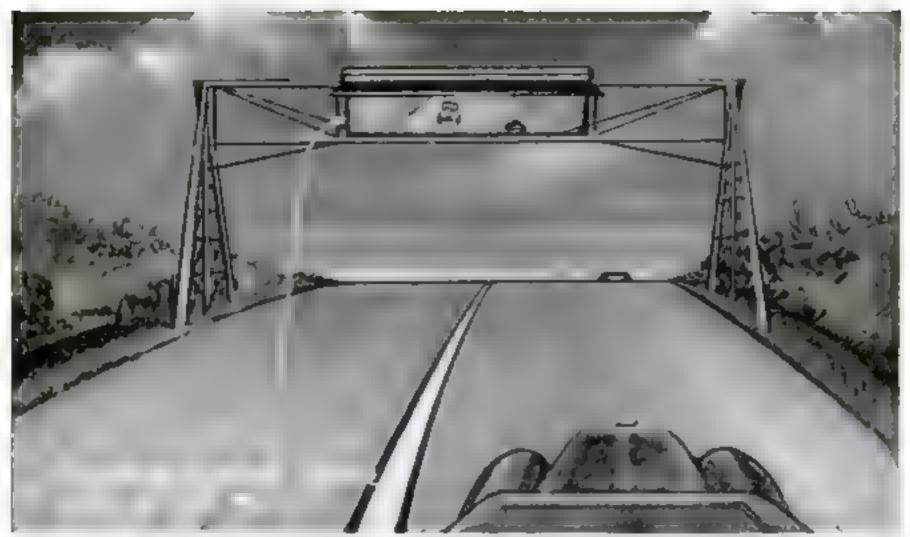
ROADS THAT ACTUALLY SPEAK to work against special hazards have been tried out. Tires rolling over the ridges behave like a needle on a record.



YOUR EXACT SPEED will be flashed before your eyes if you travel too fast. Photoelectric cells compute the speed and flash it on a bulletin board.

I was just mulling over the possibilities of these divider curbings," he confided. 'Here is your perfect arrangement for lighting. I've never been satisfied with overhead illumination because it tends to give an eerie appearance to a lot of things that are of no aid to the driver. His attention



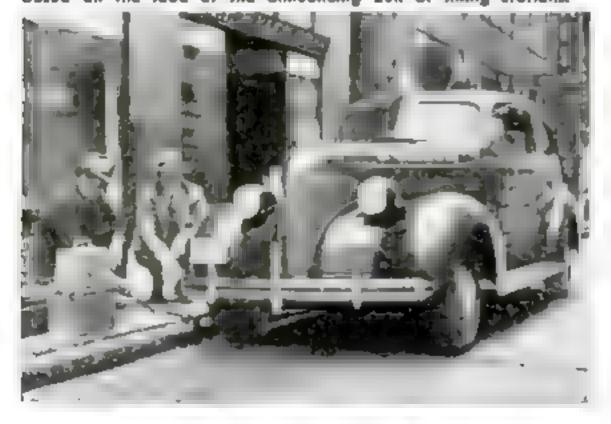


Acting on the principle of your reor-view mirror, giant mirrors above the crest of hills show you what to expect on the other side. They prevent head-on collisions on hilltops and crashes into stalled cars.

is distracted by things he wouldn't even notice in daytime, and that's bad for concentration. At night chief interest should center on the highway itself and there should be a clear view of the situation shead. Floodlights along these divider curbings are certain to be among the new highway accessories. And right here, too, we have a perfect opportunity for skid control."

He showed me a sketch of a divider in which a metallic grating registered temperature and surface conditions on high-ways. Impulses were relayed to automatic sprinklers that would spray out a chemical to melt ice and snow. Another dream was

Detroit has a counter that can be used to check on car speeds, operate traffic signals, and control animated warnings. It is based on the idea of the announcing bell at filling stations.



of signs on the road surface so a driver would not have to look to the side to see where to turn off. Light from the divider would make these signs visible at night or in a fog.

Predictions that tomorrow's cars will carry phonograph turntables and pickups to play auto-club instructions on routings have suggested another highway accessory. The idea is to space minor obstacles on the road surface so tires rolling over them will produce a phonograph effect and the road will actually speak to the driver, cautioning him against some special hazard. A scheme of warning by highway surfacing was tried

out in a Connecticut town where a sharp bend in a new road caused many strangers to go straight ahead on the old road. Some 200' down the old road there was a dangerous intersection with a main highway, and beyond that the road went into an unimproved stretch with a narrow bridge. A local manufacturer conceived the idea of roughling up a portion of the old road to tip off a driver that things were not as they should be.

Various patterns were laid on the road surface to test effectiveness. One almost played a tune on cars. It was so effective in slowing down those who had missed the curve that automobile clubs were



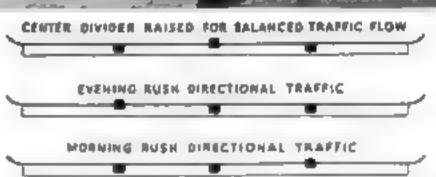
CURBINGS THAT RISE to divide traffic are now on Chicago's Outer Drive. Hydraulically operated, they break the road into varying-width lanes. A 600' strip can be lifted in 111/2 seconds.

asked to aid in having the State adopt the idea for all approaches to dangerous spots. The war checked further progress.

Predictions are rife of gadgets based on electronics—electric eyes that automatically turn on headlights, small radars to warn of the approach of other cars, and traffic signals visible inside the car—but in the era just ahead, whatever is put to use will work with old cars as well as with new. There can be no double standard, for then some of the cars would fit into the scheme while the rest either would not be affected at all or, still worse, would get their signals crossed.

Any car, for instance, will activate a photoelectric cell, so warning systems can easily be set up to advise drivers when they are traveling too fast. Two spaced counters compute the speed automatically and flash it ahead on a bulletin board. These boards—some have already appeared—could be revised to warn of other things, some relayed by radio or wire from central stations manned by auto-club or highway-department monitors.

Many highway gadgets must await further development of cars themselves. Power steering is definitely in the cards, but until it arrives there is little chance that automatic steering, such as that invented by Evan L. Sitter, will make its appearance. In this system a guide line in the center of



the road lane activates photoelectric cells when a car deviates from the straight path, and these cells control the steering motors to bring the car back again.

Check your car accessories and you get a hint of what may appear on the highways. You have gears to aid in climbing grades and brakes to halt your car. Your highway of tomorrow may have varying grades in hilly sections to match the low, second, and high of your car, but the object will be to enable you to climb the entire ascent in high gear or possibly in overdrive.

On the downgrade expect to see experiments with sids to braking. Why have a perfectly smooth surface when the descent can be broken with varying gradients to ease off momentum and save pressing on the brake? You have doubtless seen ribbed road surfacing for sharp upgrades. They were designed to aid uphill traction. The same idea, exaggerated, could be used in slowing cars down.

What the well-equipped highway will wear in the new era ahead will depend largely on the fittings of your car. But considering that even today's war-worn car is "accessoried" well beyond its contemporary highway, you are justified in viewing the road ahead with high-octane optimism.

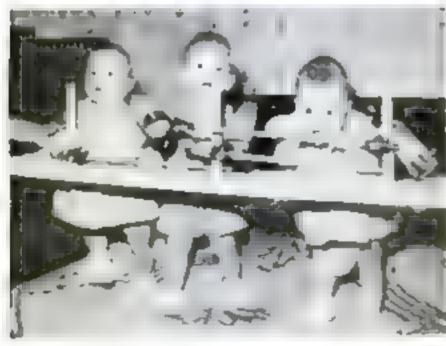
CRAFTSMEN AT WORK

HOW SMALL A MOTOR will actually run? This one, built by Merle L. Bassett, of Bremerton, Wash., does. It is .058" by .058" by .058" by .062", contains 11 pieces including a .004" diameter shaft and eight turns of No. 40 enameled copper wire, and develops 13 billionths of 1 hp. at 3,600 r.p.m. and .017 volts. The thing behind it is a pin.





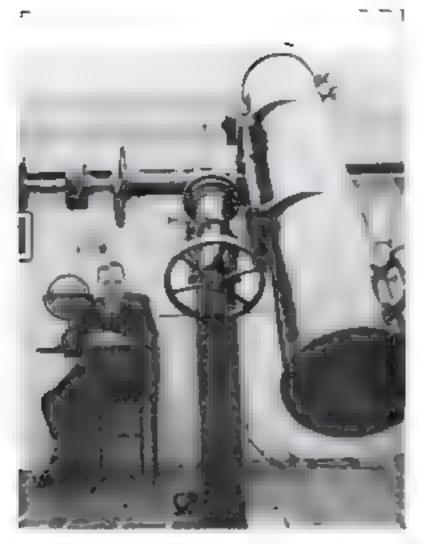
TIN CANS AND MAHOGANY retrieved from scrap heaps during repairs on PT boats being made ready for the invasion of Sicily make up the marimba shown above. The sounding bars are mahogany scraps and the resonators soldered cans. Thomas Evans Moon, Sicilian campaign veteran now in the Naval Hospital at St. Albans, Queens, N. Y., assembled them before the invasion.



TRIPLETS CAN BE FED without undue commotion if you are an ingenious genius. The device shown above gives Doreen, David, and Donna Lee MacLeod their bottles at the same time, but it's up to them whether they take them or stare at the camera. Bottles are clamped to adjustable brackets on a baseboard and can be turned to any position. The gadget was built by their father, Raymond A. MacLeod, of Weymouth, Mass.

MODERN SIDE-WHEELERS are propelled by gasoline. At least that is the idea of young David Bucher, who devised the 14' boat shown below. It is powered by a 2-hp. gasoline engine connected by a belt to a shaft on which 30" side-wheels are mounted on both sides of the boat. David is being helped in the photo by his father, George H. Bucher, at their summer home on Lake Mohawk, N. J.







R. G. Stephens and his homemade telescope set up in his observatory in Kennebunk, Maine. The 12^{1/2}" mirror in the powerful instrument was ground in his own home shop, where also all patterns were made and all the necessary machining was done.

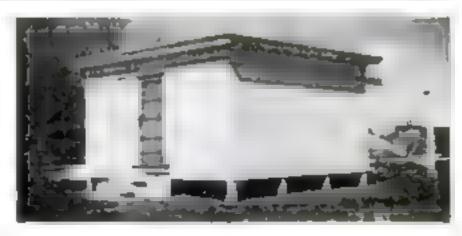
The moon photo at right above was made through the telescope with a %" negative in a plate holder. At right a view of Stephens' observatory from which he keeps on eye on the stars and planets.

SEEING STARS is a hobby that grows with age, and R. G. Stephens, of Kennebunk, Maine, helped to prove it by building the powerful telescope shown above when he was 74 years old. Painstaking grinding of a 12½" mirror for the instrument was the most difficult part of the project.

In order to shift the telescope around for observing various stars, he adapted an idea from an old issue of POPULAR SCIENCE

MODERNIZING AN OLD ORGAN was a project that required fitting an outmoded pump organ with a composition-board cabinet and installing a motor "bellows." Richard Beemer and Gerald Allen, of Mason City, lows, discarded the old bellows and retained only the keyboard assembly including the stops, reeds, and wind box. On a framework of two by fours, they screwed \%" composition board, bowing the front.

A high-speed dental-lathe motor with a vacuum-cleaner fan housed in a wooden box was installed with a vacuum-cleaner coupling to suck in air when keys are pressed. Sound grilles cut in the cabinet were made dustproof by a cloth covering.



MONTRLY and built an observing stand that would sustain a heavy weight and yet could be revolved quickly on a swivel truck simply by pressing down on a lever. A motor drive keeps the telescope following a given star for hours at a time.

Photographs are taken on %" square negatives in a homemade plate holder without use of an additional lens. They can be enlarged successfully to 10 diameters.



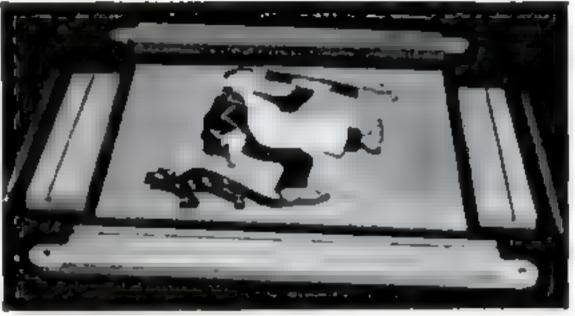
Comic Cutout Hands You a Laugh on a Tray

BUILT up of three layers of wood between the background and the top glass, a comic figure helps to make an amusing refreshment tray. The three-layer cutout brings out the effect of three dimensions.

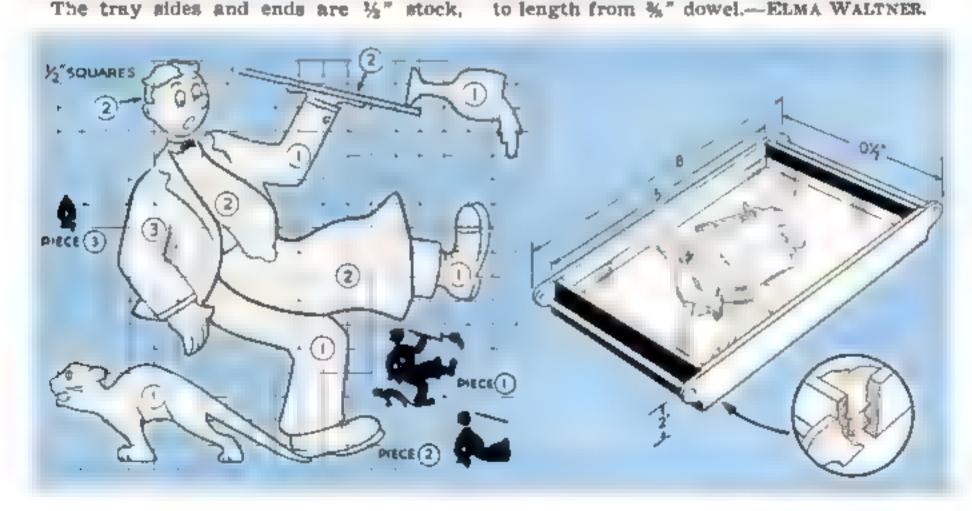
Use double-thickness windowpane for the top glass, and have it cut to a 10" by 14" size. The background piece on which the figure is built up may be ¼" wood or heavy cardboard.

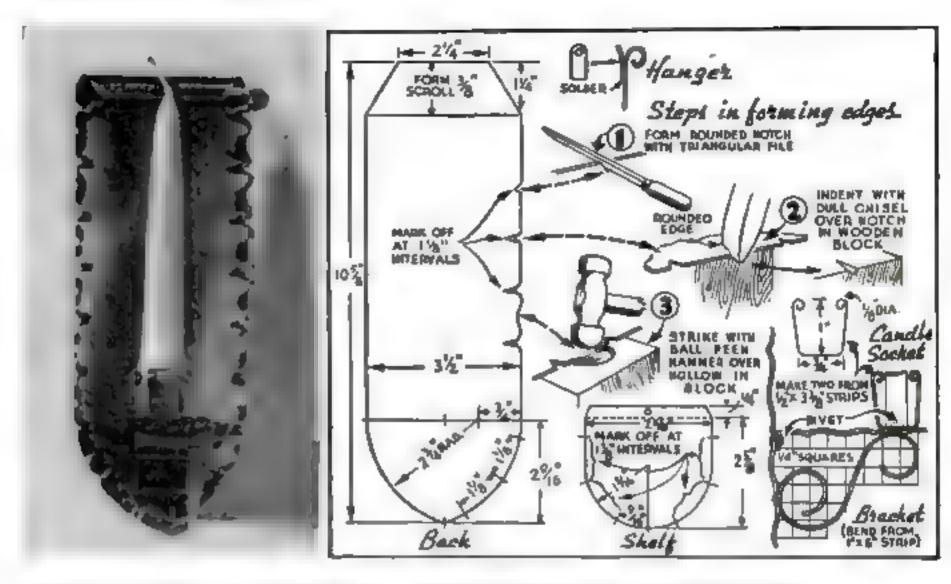
Tack together in the waste three pieces of 14" wood, lay out the figure on the top, and cut out three figures at one time with a jigsaw or coping saw. One piece, shown as No. 1 in the drawing, is left as it is, becoming the bottom layer and exposed as the far arm and leg of the figure, the abused cat, and the waiter and tumbling tumbler. These No. 1 parts are sawed off the second layer, which becomes exposed as No. 2, the head, shirt, apron, and forward leg and foot. The top layer is only the forward arm and part of the coat, as shown by No. 3. Round exposed edges with sandpaper.

If the figure is put together with fine brads driven in from the back, the pieces can be painted before assembly, but if gluing is preferred, finishing should be delayed until the figure has been fixed on the background. Attaching to the background may also be done with brads or glue.



the long rails being grooved 4," deep to take both the background piece and the glass, and the short rails being grooved only to take the glass. Round and shape the ends of the long rails as indicated and drill nearly through to receive handles cut to length from 4," dowel.—ELMA WALTNER.





SCONCE OF TIN-CAN STOCK IS A DECORATIVE WALL CANDLEHOLDER

FAIRLY heavy stock from a large can will make up into an ornamental scence to hold a single candle. If only thin material is at hand, two thicknesses may be sweat-soldered together. Copper or aluminum, if available, makes a handsome piece.

Lay out the back and shelf as shown in the drawing. Edges are formed in three simple steps, as indicated. Shape the candle socket from two strips and rivet it to the shelf; then rivet the shelf to the back 2" from the bottom. This makes it easy to solder on the scrolled bracket because the riveted parts remained fixed while heat is applied. Solder is also run in between the shelf and back. Bend the top scroll of the back over a %° rod, and then solder on the hanger.

Several finishes are appropriate. Dull black paint applied to the depressed parts of the sconce shown gave the tin-can stock a good antique appearance. Bright parts may be burnished with steel wool and waxed or lacquered to preserve the luster. As an alternative treatment, the sconce may be enameled in color.—H. W.

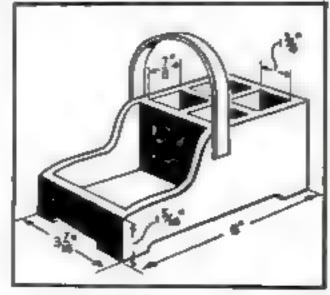
MINIATURE BLACKSMITH KIT SERVES AS FOUR-BRAND CIGARETTE BOX

This miniature reproduction of a blacksmith's shoeing kit has four compartments in the rear half to hold cigarettes. The server itself is only \$7/16" by 6", and the cigarette compartments are %" by 1%".

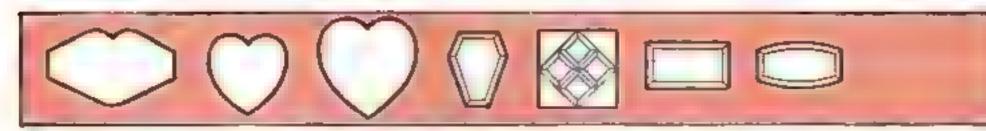
each being large enough to hold 12 cigarettes. Since they stand on end, kingsize as well as standardsize cigarettes can be accommodated, and a different brand may be held in each compartment.

Light veneers can be employed to make a piece that will show real crafts-manship. The aerver shown, however, was made from well-sanded 4" pine,

given an antique-white finish, and decorated with bright decals. It was built with butt joints glued and lightly bradded throughout. The handle was bent to shape from thin veneer.—WILLIAM FREEMAN.







MOTHER-OF-PEARL JEWELRY CUT FROM

By Nicholas S. Tranchina

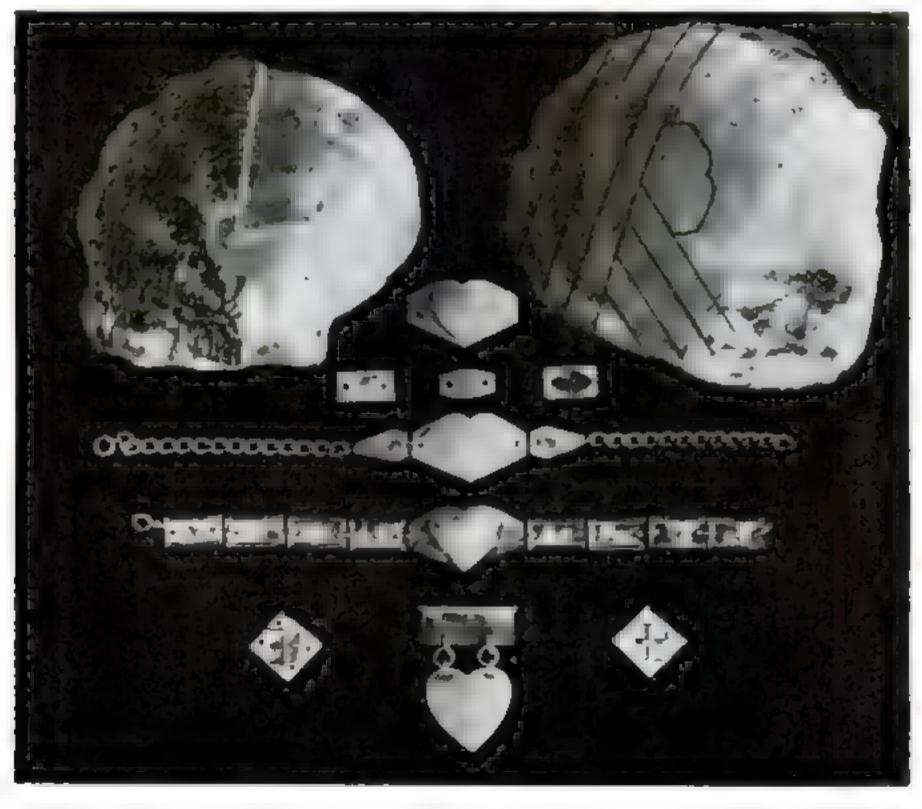
THOSE who visit the seashore, and inland waters as well, have the means of an interesting and profitable hobby at hand. Shell gathering has siways held an attraction, for many shells have an intrinsic beauty that makes them ornamental in themselves. These same shells, and some that show less immediate beauty, can be ground, sawed, and filed into shapes that make up into handsome jewelry and other trinkets.

True mother-of-pearl is available in abundance from such shells as those of pearl oysters, river mussels, and abalones, but the inner layer of conch, clam, and common

oyster shells and some others is quite as serviceable and often as delicately colored. The coarse outer layers must first be ground off. A shell with these coarse layers half ground off is shown at the upper left of the photo below.

Patterns of tin-can stock or other material are laid on the shell and traced, as at the upper right in the photo below, where the straight lines are for strips that can be cut into links. Saw these with a hacksaw, and then saw the centerpiece, which should be from the best part of the shell. Links may be 3/32" thick, centerpieces %". Patterns for several kinds of links and centerpieces may be traced from the drawings above.

Shape pieces with a file, bevel or round





SEA SHELLS

the edges, and drill with a 1 16 dental or regular short drill. Sand off scratches and polish with jeweler's rouge or stick metal polish

Stiff link wire can be purchased a foot or two at a time from a jeweler's supply house. To make links, wind it around a nail and saw through along the length of the nail. A brooch clip is made as shown below.

It shells are unavailable, old shell and mother-of-pearl buttons will afford material

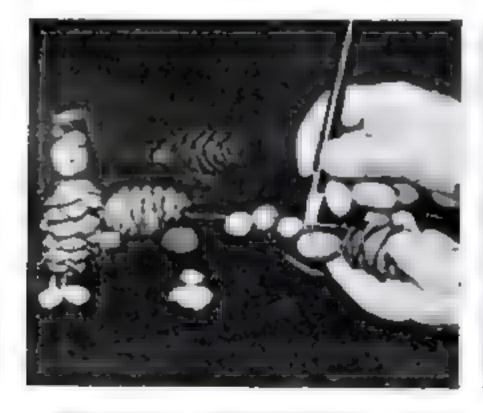




AMUSING DOLL-LIKE FIGURES ARE FASHIONED FROM PINE CONES

Novet comic characters for entertaining children, adding to a knickknack shelf, or furnishing a table-top photographer with subjects can be made from odds and ends found in the average garden.

Pine cones serve as the bodies, acoms become heads when the features are marked in with a grease pencil, and matches or toothpicks are used for arms and legs. The parts can be attached firmly enough with certain types of modeling clay or wax jammed into the cones. Blobs of the modeling material make feet that let the figures stand upright.—Sidney Pott.





"Fore!"

Nine holes of table golf laid out on a cardboard course and played with midiron and putter,



the hands of the "golfer."

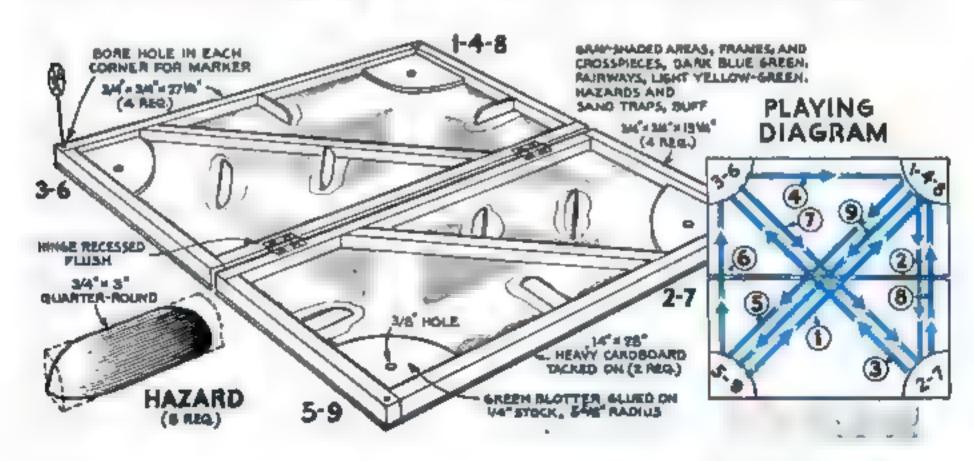
The course is built of heavy cardboard tacked to two frames of %" by %" stock which are hinged together for folding. Two diagonal pieces serve both for reinforcement and for course hazards. "Bunkers" are whittled from %" stock and glued on. Four "greens" are cut from %" plywood, a %" hole is bored in each, and the plywood is then covered with pieces cut from a greep desk blotter.

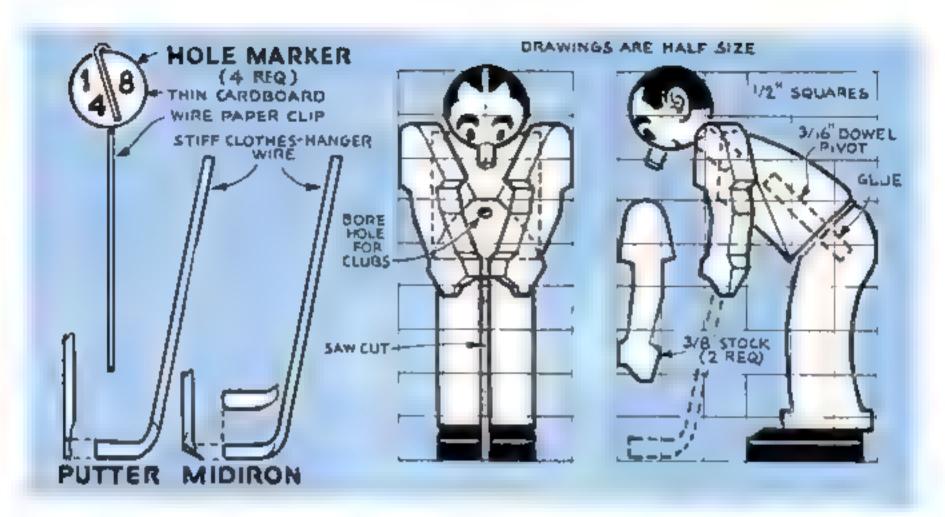
Although there are only four holes, a regulation nine-hole game can be played by following the course as indicated by the



dotted lines and arrows in the drawing at the right below. Tee off from the ninth hole to play the first, from the first to play the second, and so on. Par for the nine holes is \$2, four strokes each for the diagonals and three each for the sides. A penalty of two strokes is added for driving out of bounds, and the bail must be played from a lie 1" behind the bunker or diagonal hazard nearest the hole being played. When a lie is next to a wall or in a corner that prevents a free swing, it may be moved 1" without penalty. An 18-hole game may be had simply by playing the course twice

The golfer is made in two pieces and swings from his waist on a 3/16" dowel pivot. His head is a large wooden bead mounted on another dowel. A hole bored in his chest receives the end of the golf clubs, which should fit tight enough to stay in place but not so tight that they cannot be





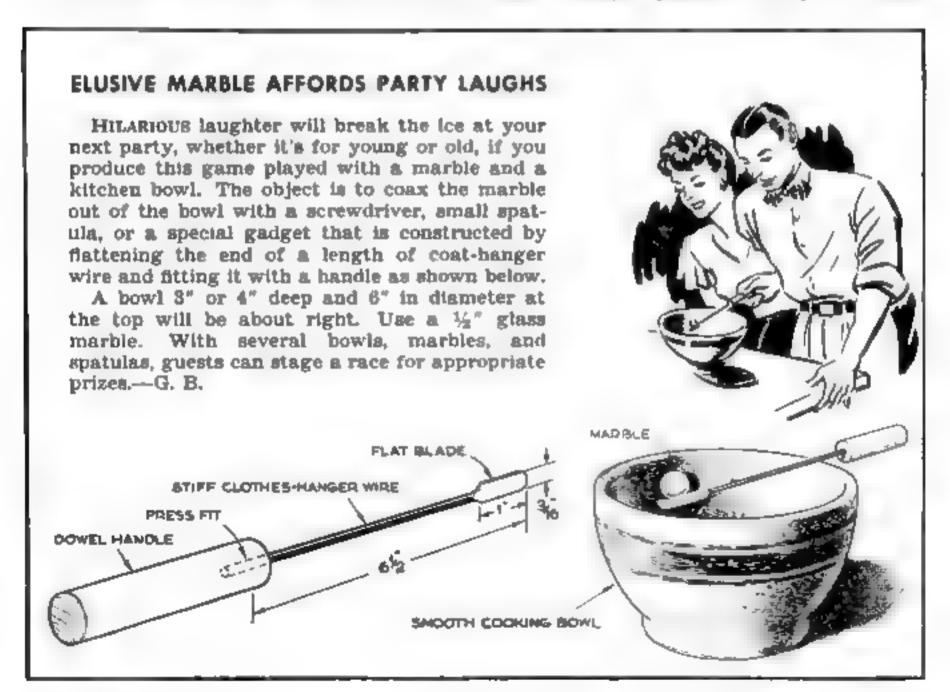
adjusted for length or changed as necessary.

Clubs are made from coat-hanger wire. Bend the heads, flatten them with a hammer, and trim and finish with a file. If the midiron is flattened at the approximate angle, less twisting is required and the danger of breaking off the head avoided.

The midiron gives a surprising lift to the ball, which can be lofted a dozen or so feet

without difficulty. This makes it possible to play the game on a much larger course laid out with movable bunkers and hazards on the floor if you wish.

Golf balls about 4" in diameter are best. Use wooden beads, shaped plastic composition wood, or whittled dowel ends. Prese the surface with serrated-jaw pliers to make backspin possible, and paint white.



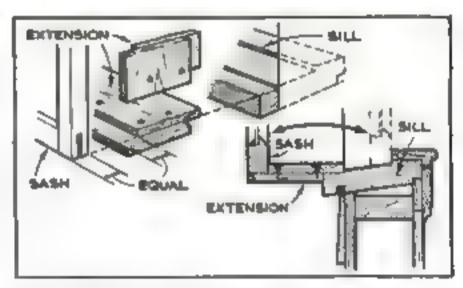




SUNNY BAY WINDOW PROVIDES WINTER GARDEN SPOT

A GARDEN window that will allow you to grow colorful flowers in the wintertime can be secured by setting a single-casement sash 7" or 8" outside its normal position. The space so achieved is both an excellent place for growing winter plants, provided you select a southern window, and a bright center of interest in room decoration. Plateglass strips will act as shelves for plants and do not cut off the light.

For the extension use paired pieces of 1" by 8" stock offset by the width of the sash and with the inner pieces cut shorter, as shown in the drawing. Cut and screw together separately the pieces for the sides, top, and bottom, and then screw each unit in place around the frame. The window it-



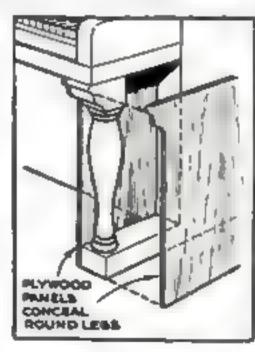
self may be held by acrews driven in from the outside of the extension.

If constructed with care, the extension will be weathertight. A slanting board above, accurately fitted and set in roofing compound, will keep rain and anow from collecting on top.—FAY ROWSOME.

WALLPAPER MODERNIZES OLD UPRIGHT

ONE way to redecorate an ungainly old piano is to cover it with wallpaper pasted on just as in papering a wall. The new face of the piano shown is a knotty-pine design, but many novel effects are possible with various other wallpapers selected for the room in which the piano is located.

Roughen the original piano varnish by sanding lightly if the paper won't stick well. Two or three coats of clear varnish over the paper give a good finish.—HARRY SCHLOSSBERG.



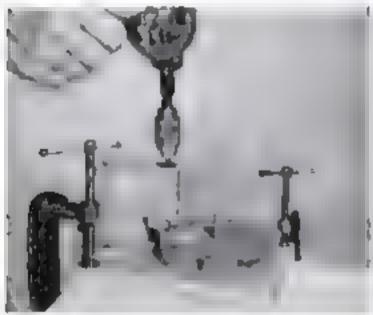
Unsightly logs are covered with plywood, as above, the obtain the effect at right.





Basket-Weave Flowerpot Holder

TWO homemade wood jigs speed the making of a flowerpot holder like that shown at left. Cut a plywood ring to fit under the pot lip and project around it about ¼", and make a disk of the same diameter for the bottom. These are held together with dowels, around which is woven basket splint or other thin stock.—B. B.

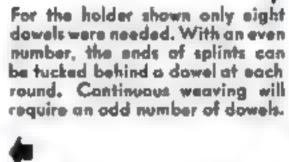


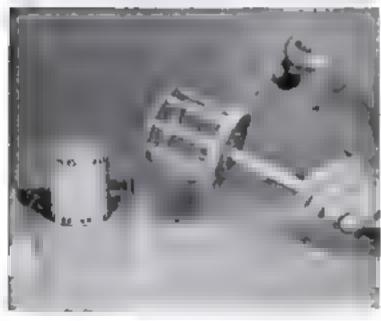
Noil the disk and ring tagether lightly. Drill downleize holes through the disk into the ring. An upright black with a hole in it keeps the bit truly vertical. The disk and ring turn on a peg.

Dowels will be the same length if they are cut in a jig like that at right. Make them long enough to permit use of a can end or a glass or china receptacle under the flowerpot to catch seepage.



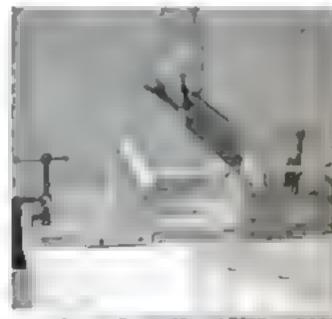
Assemble the ring and disk with the dawels, putting a few drops of glue in the ring holes and on the disk end of the dowels. The number of dawels used depends on the diameter of your flowerpot.





Paint the holder and let it dry tharoughly before weaving. The flowerpot can be decorated on its lip, as in the photo at top. If a tin can is to catch seepage, paint it also to prevent rusting.

Basket splint, purchased in the width desired or ripped to size on a circular saw, is soaked to make it pliable. Strips of thin plastic, linoleum, sheet metal, or fiber are good substitutes.







WHITTLING THE VENTURA PV-1

Speed, Range, and Stamina Have Earned for Lockheed's Bomber the Title of Most Versatile Weapon of the Navy's Air Fleet

AIR POWER, it has been said, crushed Japan into submission while its home armies remained intact. If this is so, planes like the Ventura should come forward for a bow. According to the testimony of the men who flew them, these craft didn't know when they were dead. If they did, they stubbornly refused to give in. Time after time they battled off superior forces and hobbled home to safety with wings torn apart, one engine dead, and landing gear inoperative.

One Navy squadron completed eight months of intensive operations in the Central Pacific with only one plane lost in action. This record was achieved despite the fact that at one time or other every plane in the squadron was damaged by antiaircraft fire while in a combat zone.

In the Navy, the four-seater PV-1 served as a land-based patrol ship, and carried either bombs or depth charges; its Army counterpart, the B-34, was a medium attack bomber.

Two Pratt & Whitney engines deliver 4,000 hp., driving the plane at a speed of 300 m.p.h. Eleven tons of fighting aircraft are packed into the 51' 6" of length. The ship has a span of 65' 6" and a service ceiling of 25,000 ft. Each of the engines turns

The plans given on the next page can be worked out in balsa, pine, or other wood of your choice. Carve the fuselage out of a single block; the many projections on the fuselage, wing, and stabilizer faces can either be modeled integrally or cut separately and glued in place.

a three-bladed hydromatic propeller.

Two droppable fuel tanks are shown in the photos but omitted from the plans; they can be added to the model if your patience and desire for realism hold out.

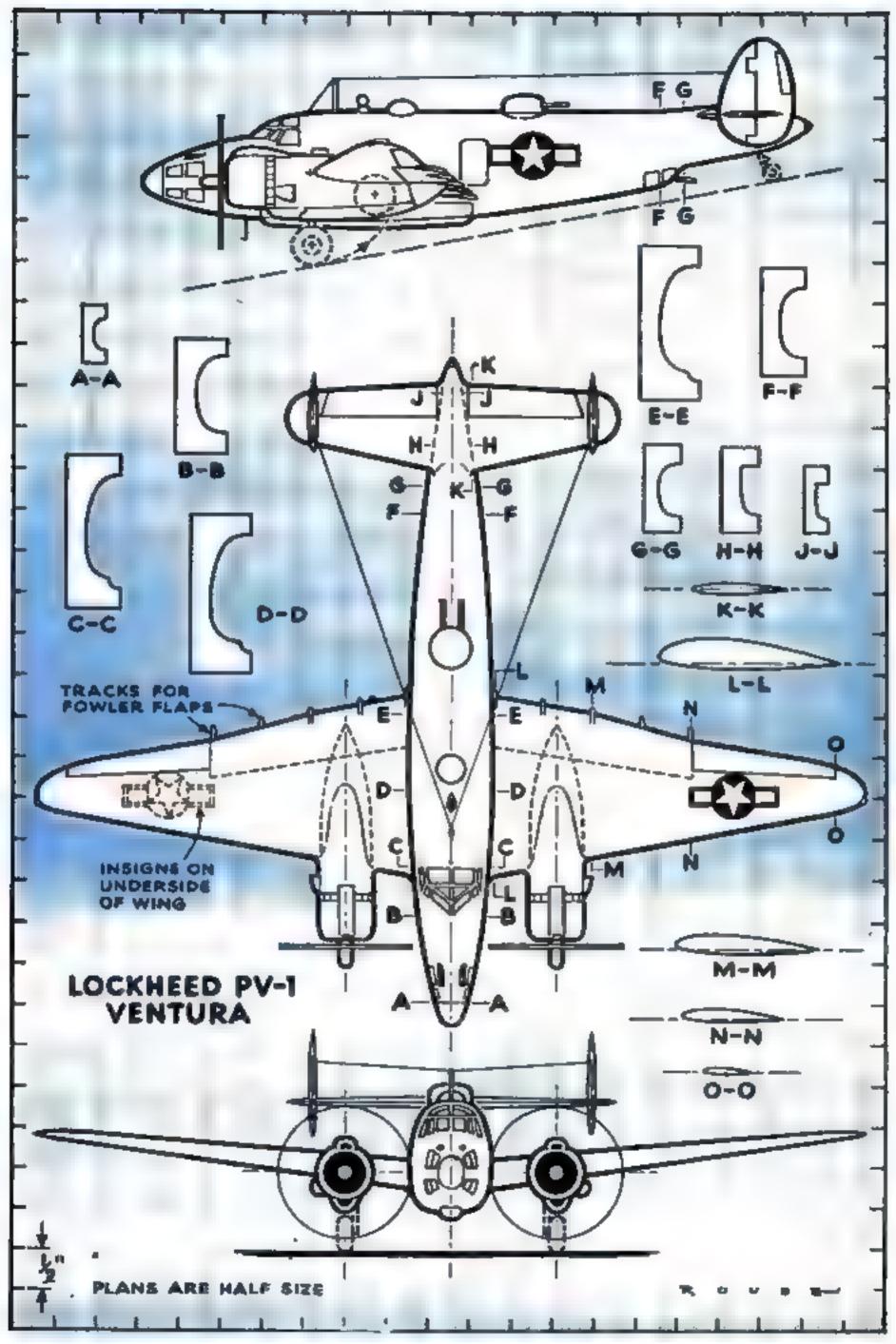
Glue up the parts and sand all surfaces smooth. Finish with several coats of aluminum lacquer or dope, sanding between each coat.

Glass-enclosed housings can be effectively simulated by painting them white with a black-line trim. A circular celluloid strip mounted under each spinner gives the illusion of a whirling propeller.

Two views of the Ventura in flight. A part of the vost armada that blanketed the skies over Japan, this Army-Navy bomber took everything the enemy could throw at it and kept coming back for more.







TRICKS WITH WALLPAPER



Archways and alcaves of the kind shown above, frequently found in bathrooms, pose difficult matching problems for the amateur. To match the horizontal bands is impossible without patching.

At left below, a typical break in pattern continuity that results from surved adjoining surfaces; at right, the patch that fixes it.





By MICHELE de SANTIS

S MANY a home owner who has done his own redecorating can testify, hanging wallpaper isn't as hard a job as you might think from watching the deft work of an expert. It does take patience. care, and the willingness to be finicky over small details. Often paint and paper shops will help you select the materials and equipment needed for your job, will estimate the number of rolls required, and will give good advice on preparing the walls.

Most rooms with the usual rectangular walls and standard doors and windows offer no special problems: but it is the room with an irregular shape, such as a bathroom with arches, alcoves, or niches, that leads to papering complications. Because of these irregularities in wall surface, it is almost impossible to make adjoining lengths of paper match in design, and this interruption of the design creates disturbing breaks in the continuity of the pattern.

One simple way to overcome this is to cut the incomplete section of the design from a piece of waste wallpaper, if possible, or from an extra roll if necessary. A pair of scissors is used to remove all background material, leaving only the part necessary to complete the design unit. This cutout is then carefully pasted on the wall in such a way that it will completely cover the unmatched section of the patern.

For example, if as in many bathroom wallpapers there are horizontal patterns in the form of waves, the waves themselves can be cut out and pasted on in such a manner as to conceal many breaks in continuity. These breaks are bound to occur when corners are turned into curved alcoves

or the like. Most bathroom wallpapers have aquatic scenes or flowers that readily lend themselves to this trick.

Another expedient, useful not only in bathrooms but also in other small rooms, is to decorate the inside panel of the door with designs cut from the wallpaper used in the room. The purpose of this is not merely to decorate the door; a second and often desirable effect is to create the illusion of a larger wall area and hence a

bigger room. Depending on the pattern of the paper, you may appliqué on the door either one large design or several small ones. As a rule the illusion of spaciousness will be heightened by a large design over the entire panel.

When valances are used in a room that is being repapered, it is sometimes an attractive stunt to paint them to match the woodwork and then to applique to them one or more small design units. This may not be desirable in cases where the paper design is heavily repetitious, so you may want to attach the cutouts temporarily and study the effect.

Two things are worth remembering in connection with any patching that may be necessary months or years later. The first is to tack up a left-over piece of

The designs that appear on the door of the bathroom below were taken from a scrap piece of the same paper used on the walls. They were cut out with scissors.

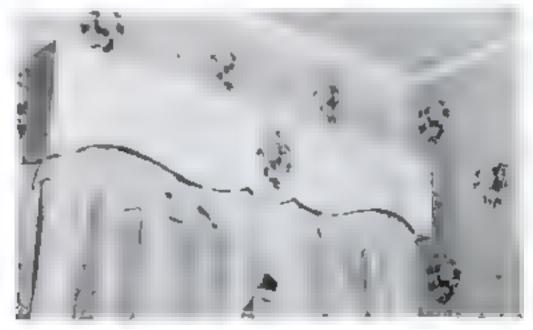


paper in an attic or storeroom so that it will age naturally. Repair patches taken from such an "aged-on-the-wall" strip will match far better than pieces taken from a rolled-up remnant. The second idea is to tear, rather than cut, the piece selected for patching. Hold the paper, pattern up, on a flat surface and tear the desired patch out by pulling it upward. If this piece is carefully pasted on, the resultant patch cannot be detected by casual inspection.



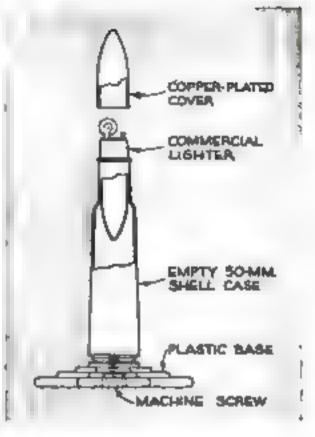
To secure an illusion of greater spaciousness in the small bedroom above, the entire panel of the door was papered as well. An apparent increase in wall area causes this effect.

The repetition of part of the paper design on the valence makes an attractive decarator's touch in this bedroom of a young girl. However, it's a good Idea not to averde this.









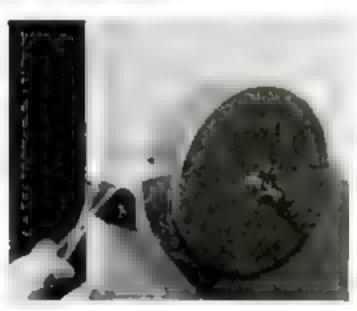
CIGARETTE LIGHTER MADE FROM WAR MEMENTO

BOTH as a war souvenir and a useful accessory, a table-model cigarette lighter made from an empty 50-mm, shell will be appreciated. The mechanism is taken from an inexpensive builet-type lighter and installed after the shell opening has been stretched enough by lightly hammering in a piece of round stock of the proper diameter. A base is shaped of plastic or metal and attached with a small machine screw.—A. O. BOHR.

STATIONARY CELLULOSE-TAPE DISPENSER HELD ON CUPBOARD

Installed on the side of a cupboard or a shelf support, this cellulose-tape dispenser is out of the way and yet slways handy. The axle bolt goes through the support as well as the turned drum over which the tape spool fits. Make the cover of composition board, heavy cardboard, or tin. The knife is heavy tin plate with the serrated blade set at an angle.—Will Thomas,





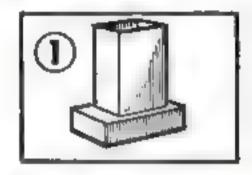


SCALE INCREASES ACCURACY OF HOT-AIR VALVE ADJUSTMENTS

BY ADDING a pointer and scale to the valve-adjustment knobs usually found on basement hot-air pipes leading to individual rooms, you can make settings with fair precision to assure uniform heat in an entire house. Cut the scales from sheet asbestos, draw the divisions to include at least a quarter circle, and glue to the pipes just above the adjustment knobs. Make the pointers either from sheet metal or heavy wire, but be sure to attach them firmly so they won't slip.—BURL KNUTSON.

TABLE TRICKS

REVERSING A MATCHBOX set up as in Fig. 1 below so that it will be in position as shown in Fig. 2 sounds elementary. But wait—you must do it by touching only the casing, not the drawer! Now it sounds impossible, but it's still easy. Put your mouth on the casing and suck hard; then straighten up, holding onto the casing and still sucking, and bend your head back, as at right. The drawer comes up with the casing.



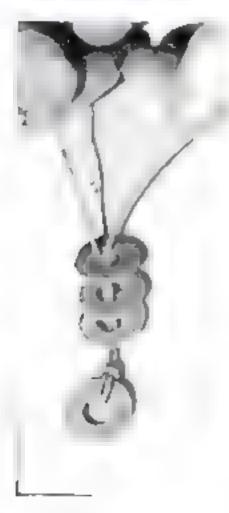






THIS ONE'S IN THE CARDS in more ways than one. Have one of your friends deal off a deck face down as many cards as he wishes after you have written the name of one card on a piece of paper, folded it, and handed it to another friend. Then have the dealt cards placed back on the top of the deck and let the second friend deal off the same number, this time face up. Watch the expressions when they unfold your paper and read on it the name of the very last card the second friend turned up!

How's it done? You simply note the top card on the deck originally and write that one on the paper. A little deduction will tell you why it's the last turned up.



leave the string intact—this is a trick requiring a little sleight of hand. Explain that the quickest way to release the washers is to cut the string at the lower washer. Have someone hold the two free ends, take the four washers in your left hand, and pretend to cut. Conceal them as you do so, and pull the loop down over the lower washer. Your friend will be surprised to see the washers free and the cord whole!

pull this one. Have someone hand you a crayon behind your back, and after a moment, whip out your free hand, point toward him, and name the color of the crayon! Be sure, though, to make a streak on your palm so you can see the color as you point.



These are some of the countless knots and gadgets made of rape. With them is Charles O. Strand, who went to sea at 14 and fallowed it for 45 years. Below, Trygve Rustad, a seafaring man for 35 years, shows tools of the ship rigger's trade—the same today as yesterday.



WHEN YOU

EVEN A LANDLUBBER, AT SEA

By Richard W. Emery

Photos by Roy Chapin

PHOSE same splices and knots used by expert ship riggers in fitting out merchantmen for sea can do much for the landlubber at home. They can mend a broken tow rope, a raveled awning line, a frayed moor-



Sewing and seizing are both important operations in working with rope. The needle used is a sail needle, and the thread or seizing is sail twine. Wazing is the first step. The twine is corefully pulled through a piece of beeswax, as shown above, so it can be drawn easily through tough materials.



COME TO YOUR ROPE'S END

OR NOT, CAN LEARN TO SPLICE IT LIKE AN OLD SAILING MAN

ing rope for the family skiff, or Junior's dangerously worn swing. Pieces of useless old rope can be salvaged from the garage or workshop and made into toys or mats.

The methods today, with a few minor bows to mass production, are those that were old stuff to sailors on Columbus's Santa Maria. Even now, at the Maritime Commis-

sion's Calship yard, where the photos on these and the following two pages were taken, retired sailing men of 20 years and more scafaring experience are employed to tie the ship-rigging knots.

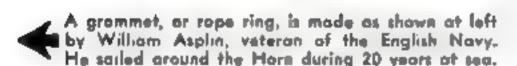
But, as Trygve Rustad, leadman there, learned 35 years ago, just get the first tuck right—then it's plain sailing.



One of the ship rigger's mainstays is the leather sewing paim. It works like a thimble on the thumb of a seamstress, but fits over the hand and has a socket into which the head of the needle goes to be braced for its hard push through braided research? or almost equally tough convas (below).



Braided cotton lines, which can't be spliced, are sewed by pushing the needle through the doubled line close to the loop. The twine is given four or five turns, cross seizings are made by looping it across the turns, and sewing through the line fostene it. Make a second seizing like the first.



And now for the splice and how it's done. Here a three-strand rope is unraveled by a professional ship rigger for a start on an eye splice around a shackle. A galvanised thimble protects the rope against rubbing and fraying. Several more turns are unraveled before insertion of the first tuck.



On the other side of the thimble, an opening is pried in the rope at the place where the first strand will be tucked. The pointed hardwood tool making and enlarging the opening is called a fid, on implement well known to seamen and similar in many ways to a marlinspike, except that the latter is made of iron. Care is taken in pushing out one strand to take the first tuck. There is an old saying among sailors: "Get the first tuck right. After that it's plain sailing." [Turn the page.]





Next, the solid fid is replaced by a fid having a groove into which one strand of the rope fits so it can be pushed through the opening. The first strand to be tucked is at the center of the three.



This center strand is tucked under the top strand of the standing rope. Here the worker holds the strands apart so they can be seen. To complete the first tuck, he grasps the tucked strand...



. . . and havis the tuck tight. Unless each tuck is pulled tight, the splice will not lie smooth. At right he tightens the tuck further by cronking the point of a fid against a bight in the strand.



The three strands are inserted alternately under strands of the standing part of the rope. Same of the yarn is cut out of each strand on its third, fourth, and fifth tuck. This tapers the splice.

When the splicing has been completed, the shackle is hooked on an iron post, the rape is put under a strain, and the splice is pounded with the fid. Pounding is necessary to make a new splice round.

After a first pounding, rough ends of the tucked stronds are cut off close to the splice in order to reduce the bulk when the splice is served, an operation in which a rope is wropped with marline.



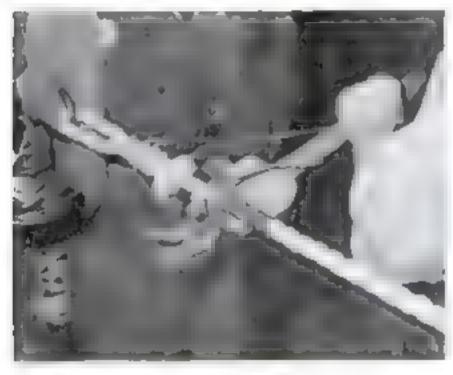




Then another thorough pounding is given the splice with the rope still under heavy strain similar to that it will get in actual service. Strain on the rope stretches it somewhat and makes it slimmer.



Nothing more than a small block and tackle like this is needed to put a heavy strain on a spliced rope. Unless the rope is under strain white it is being served, its wrappings later work loase.



And then the serving begins. Formerly this was a time-honored two-man operation in which one man was needed to rotate the ball of marline around the rope while the other turned a serving board.



Wartime production has introduced an improvement requiring the service of only one man, who uses a serving board with a reel that keeps tension on the marline by means of a bolt through the axle.

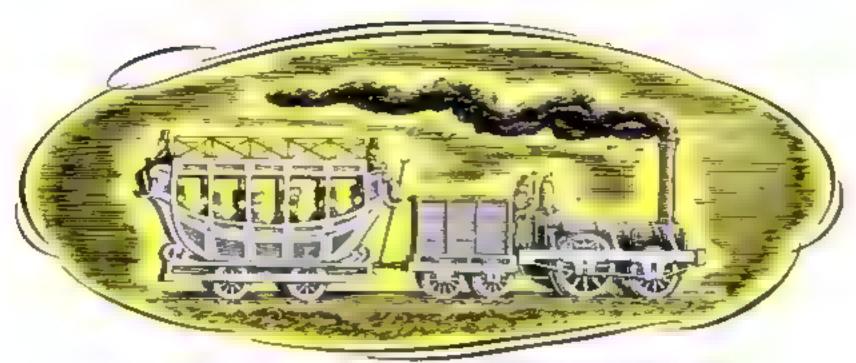
When the serving nears the thimble, a snaker is inserted and several turns of marline are wound on it. The snaker is a sharply doubled wire with which the end of the marline can be pulled back.

Then the marline end is pulled tight while lying in a groove between two rope strands. It is next pulled upward to cross the strands and is cut off. In this position It is under greatest pressure.





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OLD IRONSIDES

THE FIRST BALDWIN ENGINE

By Harry Walton

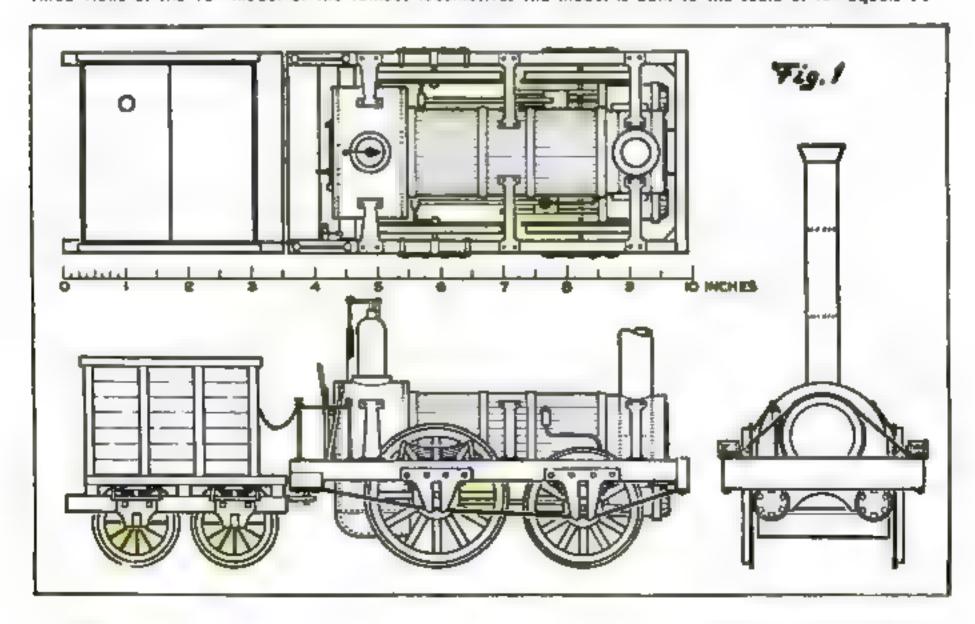
Drawings by William Patrick

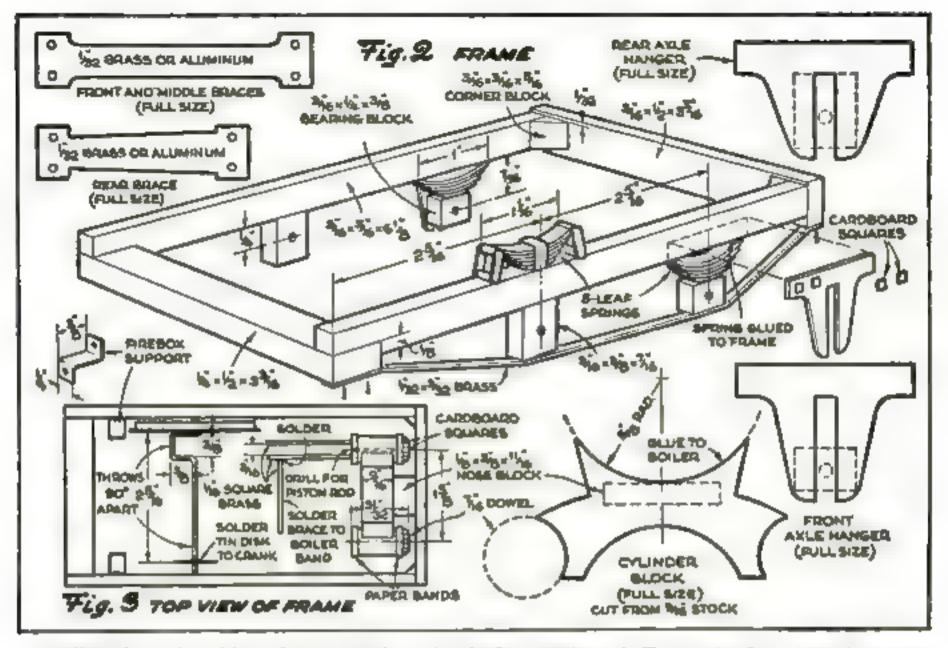
DUILT in 1832 for the Philadelphia, Germantown, and Norristown Railroad, which up to then had operated with horse power, "Old Ironsides" was Matthias Baldwin's first full-size locomotive. He had constructed a model engine before that for hauling Philadelphia sightseers, but "Old Ironsides" became the forerunner of a long line to come from his famed locomotive works. The model of "Old Ironsides" shown in Fig. 1, the photos on the facing page, and in full color on page 109 was planned to be built principally of wood, cardboard, wire, some bits of brass, and pins.

Advanced workers can, of course, build of metal throughout and add the eccentrics and rocker shafts for the valve motion. As this is an inside-connected engine, however, the omission of these parts makes little difference in the appearance of the model.

All wheels, crossheads, connecting rods, and cranks operate. If mounted on rollers,

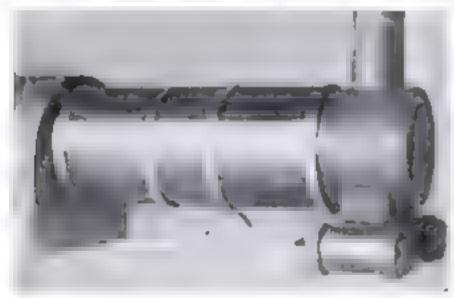
Three views of the 10" model of the famous locamative. The model is built to the scale of 1/2" equals 1".

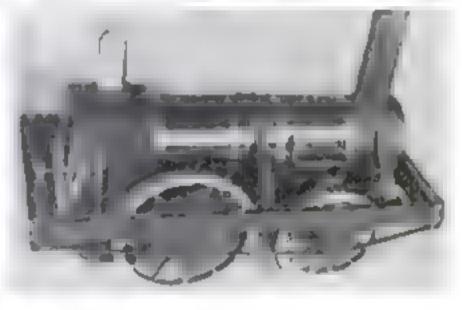




Cardboard, wood, and bits of scrap metal are the chief materials used. The wooden frame must be square.

Undersize cardboard tubing built up with a second layer of cardboard forms the boiler. Bands are thin brass. A curved piece soldered to one band braces the crosshead slides. Right, assembly in the frame.





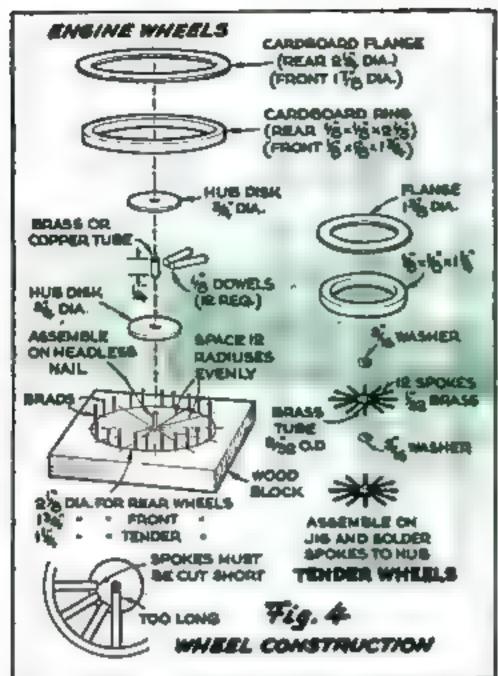
or fitted with suitable pulleys on all four axles, the model may be connected to a small motor to supply animation.

The frame of the model (Figs. 2 and 3), as of its prototype, is of wood. It is glued and bradded together, a good-quality model-airplane cement being used throughout. See that the frame is square and without twist. Axle hangers are cut from heavy cardboard and glued outside the frame, tiny squares of thinner cardboard being cemented in place in imitation of square boltheads. All the springs are built up of cardboard, five thick leaves being found to give a more realistic appearance when painted than seven thin leaves, although seven was the number the

prototype probably had. Thin tubes of rolledup paper are glued to each end of the springs and to the frame. The spring hangers are short bits of the flat ends of toothpicks, as shown in Fig. 6.

Two or three coats of dark varnish stain are given the wooden engine frame. Springs and axle hangers are painted black.

All axies are 1/16" brass rod. Cranks on the driving axie are bent 90 deg. apart. Disks %" in diameter are cut from tin-can metal and soldered on the axies to provide an adequate cementing surface for the engine wheels. Wheel bearings are short bits of 3/32" o.d. brass tubing, but they may be made by winding thin brass wire on a





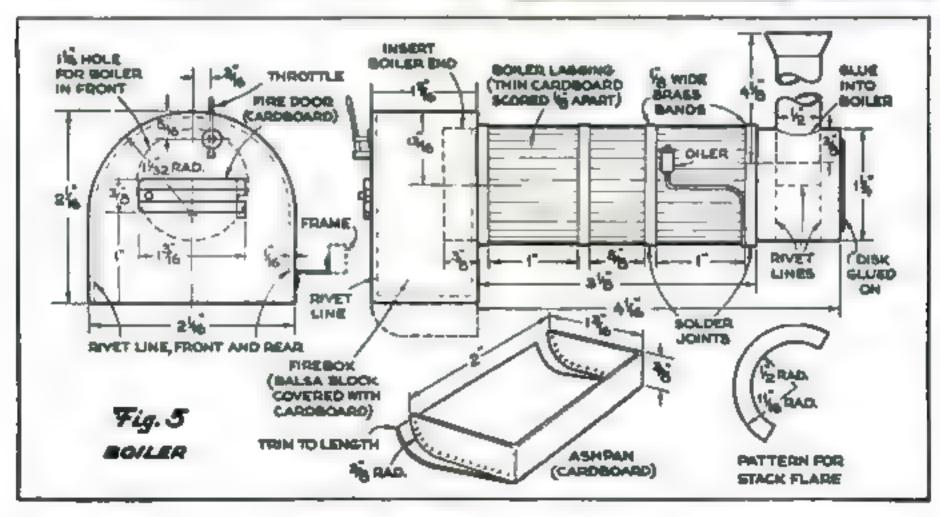
Wheels are assembled an a wood black marked with 12 equally spaced radiuses. The spakes extend only part of the way across the hub disk. Tweezers are handy for placing spakes.

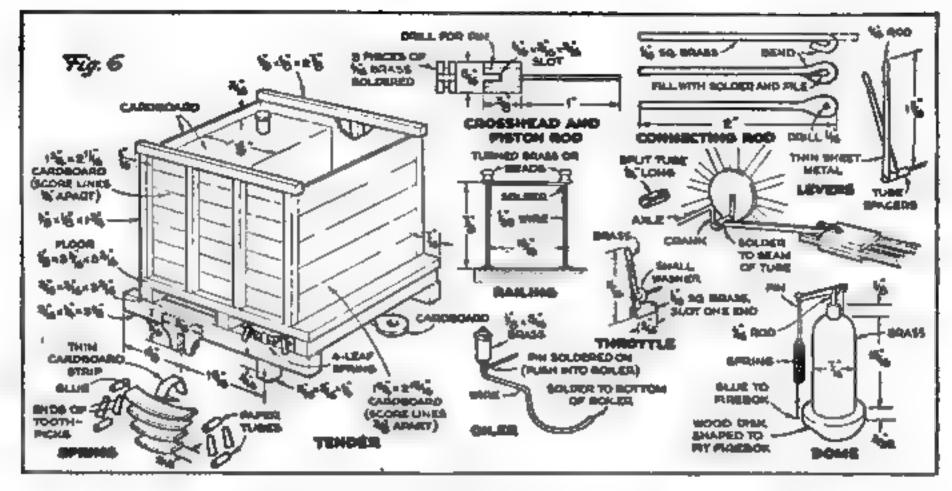
"Rivet heads" are formed in cardboard parts by punching from the inside with dividers that are not so sharp that they make holes.

bit of shaft material, soldering the turns, and cutting off. These bearings are glued into wooden bearing blocks that are later glued to the frame just behind the axie hangers. This is done, however, only after the axies, with the wheels, have been slipped into the bearings.

Wheels are assembled on a wood block on which are marked a center and 12 evenly







Bits of brass are used for some moving parts. Other fittings and the tender are of wood and cardboard.

spaced radiuses, as in Fig. 4. Headless brads or pins are driven in a circle of suitable diameter to hold the rim of the wheel being made. The rims are '%" slices of cardboard mailing tubes. These should be sawed off with a fine saw, such as a jeweler's saw, rather than cut, as a knife blade has a tendency to separate the plies.

Lengths of %" dowel are given two coats of varnish stain and then cut to size for spokes, which do not reach to the tube center of the hub. To space 12 spokes, you must cut them short and cement them to the hub disk rather than to the hub itself. The other ends are glued to the inside of the wheel rim. After the glue has set, remove the wheel from the jig and glue on the flange, which is a ring of thin cardboard.

The tender wheels are similarly made, but spokes are 1/32" rod or the shanks of ordinary pins. They are glued to the rim, but their inner ends are soldered between two 3/16" brass washers slipped over a short hub of 3 32" o.d. tubing. With care these wheels may be soldered directly to the axles. All hubs and treads, and the tender-wheel spokes, are painted dead black. The outer sides of the rims may be painted bright yellow or green by way of contrast, this being in accord with the practice of the day.

If a lathe is available, the builder may prefer to turn rims and flanges in one piece of mahogany or other suitable wood. He can then assemble the wheels as before.

The basis of the boiler is a cardboard tube, preferably somewhat undersize with a thin piece of cardboard glued around it to bring it to 1¼" diameter, as shown in

Fig. 5. This is desirable so rivet heads may be formed upon this layer. Mark out the rivet lines and carefully punch along them with a small pair of dividers set to give the desired spacing. The dividers should not be too sharp, but if a hole is made in the cardboard, it can be flattened slightly by rubbing, and painting will later quite close it.

A second layer of cardboard \$\%" long and previously scored at \%" spacing is now glued on to form the "wooden" boiler lagging. It should be just thick enough to give that effect. The lagging is also given two coats of varnish stain. Cardboard that is to be varnished or painted should be smooth surfaced, such as Bristol board.

The boiler bands are thin brass, highly polished on a buffing wheel, or with fine steel wool and scouring powder, and coated with clear lacquer to prevent oxidation. They are fastened about the lagging with a drop of solder under the boiler.

A block of balsa is roughly shaped for the firebox and covered with cardboard having "rivet heads." It may be made entirely of cardboard, but should then be well braced inside. Note that the boiler shell is long enough to fit %" into the firebox, where it is glued fast. This brings the rear boller band right up to the firebox front. The fire door is built up of cardboard.

Roll the stack of thin cardboard to \%" diameter if no suitable tube is at hand. This method allows the making of "rivets" along the seam. The height of our model and that of the Baltimore and Ohio model of the same locomotive differ. At the same scale, the B. & O. stack would be 3\%" tall, while that of the model being described is \$\%", based

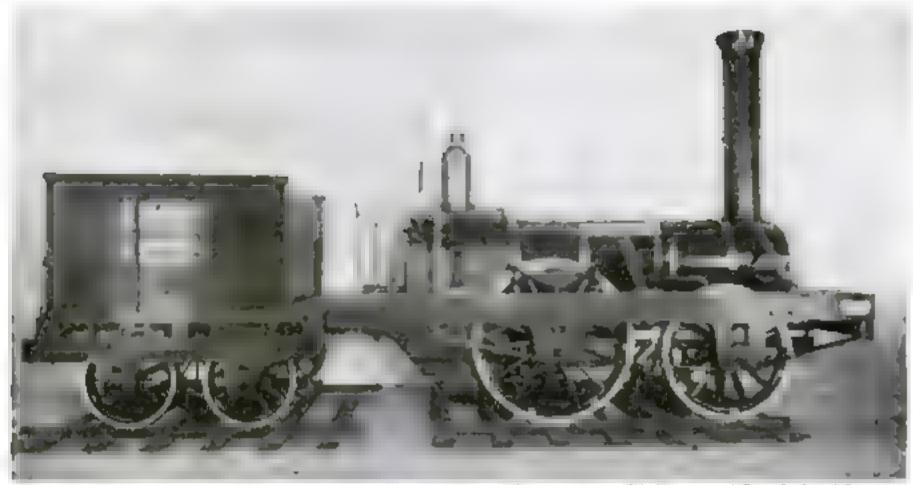


Photo courtery of Baltimore and Ohio Railroad Company.

Full-scale model of "Old Ironsides" built by the 8. & O. Raifroad in 1892 for the Chicago Warld's Fair.

on certain old drawings that show the height of the original "Old Ironsides" stack to be 90" including the flare at the top. This flare is glued up on the model from a semi-circular pattern.

Cylinders are cut from 7/16" dowel, the front ends sanded convex, and paper bands glued on (Fig. 3). An oversize hole is drilled for the piston rod and two drive-fit holes for the crosshead slides. The cylinder block is shaped to fit the boiler, and the cylinders are glued to it. One photo shows the cylinder assembly fastened to the completed boiler. The inner crosshead slides are braced by a short curved piece of 1/16" square brass soldered to the inside surface of each and soldered at its center to the second boiler band. A nose block glued just under the smokebox supports the front end of the boiler in the frame.

Two 4," pieces of 4," o.d. tubing are split lengthwise (Fig. 6), slipped over the cranks, and pinched together again to turn freely on the crankshaft. The crossheads are built up of 1/16" brass with the 3/16" wide center section filed to slip freely between the slides. Two oversize pieces are sweat-soldered to it, all solder is cleaned from the groove, a bit of 1/16" brass is laid in it as a filing guide, and the upper and lower sections are filed down to 5/16" width and the ends filed square. Crossheads are drilled for the piston rod at one end and transversely for the connecting-rod pin at the other.

Connecting rods are made of 1/16" brass, as shown in Fig. 6, and drilled for the pin, which is a small brad fitting freely but not loosely. The slides hold the pin in place once the crossbead is slipped into them.

Mount the boiler on the two firebox mounting brackets and the nose block. The brackets are glued and pinned; the nose block is glued and a single long pin is driven through the front frame member and nose block into the cylinder block. It is best to drill a fine hole two thirds of the way. Take care to have the stack vertical, the boiler aligned with the frame, and the crosshead slides at the exact height of the rear axle.

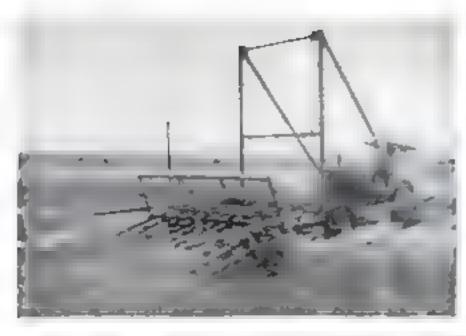
The crossheads are slipped into place, then the connecting rods are filed to length by trial and soldered to the split tubing on the cranks, the solder closing the seam.

If a lathe is available, the steam dome, oilers, railing tops, and lever handles can be turned of brass, buffed, and lacquered. Otherwise the dome can be carved from dowel and covered with gold leaf or yellow tin foil, beads may be used for railing knobs, lever handles filed from 1/16" rod, and oilers built up of .22-cal. cartridge shells and bits of rod.

The tender frame is glued up without brads, as shown, and the water tank formed of cardboard with dowel for a filling cap.

Flat black paint is used for the firebox, smokestack, smokebox, axle hangers, braces, cylinder assembly, and the like. Two coats of varnish stain finish both the wood and cardboard of the tender body and the frame, except for the black axle hangers.

A track can be made for the model with roughly cut irregular ties and %" by 3/16" wooden rails glued and bradded slightly more than 2%" apart. Glue narrow strips of cardboard on top and paint them black. Stain the ties and wood rails.

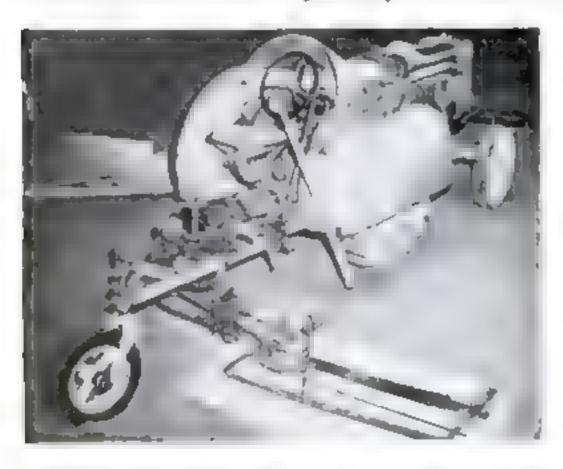




ONE-MAN BUCK AND STACKER SPEEDS TASK OF HAYMAKING IN WEST

ONE MAN using a combination buck and stacker devised by W. J. Etbauer, of Gann Valley, S. D., can haul and stack 10 tons of hay an hour without leaving his tractor seat.

Pushed in front of the tractor, the device consists of a wooden framework on the rear end of an old car. Two vertical four-byfours, 12' tall and 5' apart, are held by diagonal and horizontal braces. A fork across the free ends of two four-by-fours pivoted to the frame on each side of the tractor is elevated by a cable. This runs through pulleys on a crosspiece between the tops of the vertical posts. Power from the tractor power take-off is transmitted to the cable through an old auto clutch. For loading, the fork is placed on the ground and shoved under a shock or windrow. The operator then pushes the load to the stack, raises the fork, and yanks a trip cord.—A. EMERSON.



FARMER BUILDS HIS OWN TREE "MOWER"

BY INSTALLING a saw in place of the cutting blade of a tractor-operated mower, Bernard King, of Moline, Ill., produced a machine with which he can fell old trees in his orchard at the rate of 150 a day. Trees are cut off almost at ground level.

After removal of the entire sickle bar, a U-shaped metal brace for supporting the saw was bolted to the inside of the shoe that is found on most power mowers. Several teeth were removed from the free end of the saw so that it could operate in a slide bearing on the brace. The other end of the saw was attached to the regular connecting bar. While the device is in use, the tractor brakes are set.

VERTICAL BOOM SPRAYER COVERS TREETOPS

BECAUSE ordinary apraying methods often do not reach the tops of fruit trees, several California citrus growers have built and are using vertical-boom rigs like the one shown in operation below. The curved section at the top of the boom provides assurance that the tree crowns will receive their share of insecticide.



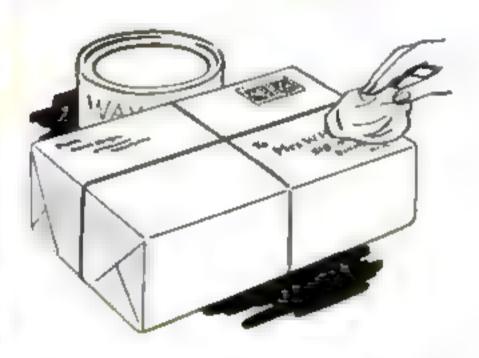
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SLOT IN BOTTOM OF CUPBOARD WAXED PAPER CONTAINER HELD IN PLACE

KEEPING



Keys can be found in a jiffy without searching through the contents of a purse or handbag, if you attach a piece of tape to the key ring, sew half a snap fostener to the tape, and place a matching part in each bag or purse you carry.



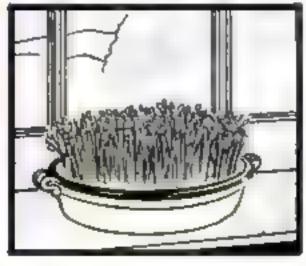
For a handy kitchen dispenser of waxed paper, cut a slot in the bottom of a cupboard. You'll then be able to draw out paper as needed from the container inside. The bax is held with strips nailed to the cupboard floor. For ease in teoring off, tack the serrated cutter along the outer edge of the slot. If you have to carry a package through the rain to the part office or mailbox and it is likely to become wet, place a bit of furniture was an same cloth and rub it lightly over the written matter after the latter is fully dry. This will prevent the water from smudging and ruining the address.

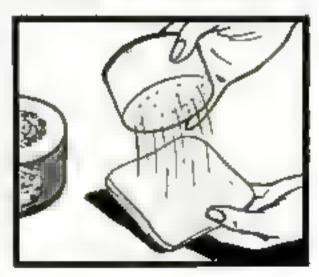
Bottoms of aluminum pans will absorb additional heat if they are brackened. This can be done by repeated rubbing with alive all and then heating. Soluble cutting all also can be used.

If other winter plants fail, try flasseed. Place cotton (no sail is needed) in a bowl and pour in all the water that it'll absorb. Scatter seed on the cotton. The shoots last two or three weeks.

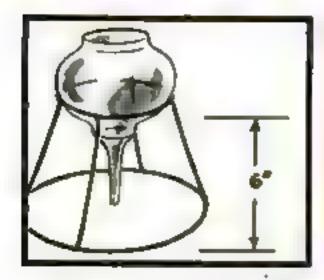
Tiny pin-prick openings in the seal of a box of powder make it possible to sift the powder and puff evenly and prevent much of the untidiness that frequently occurs when the seal is torn.







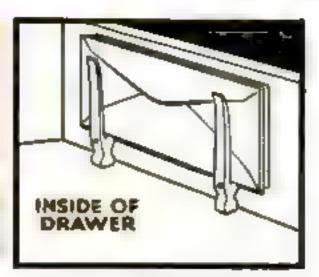
THE HOME SHIPSHAPE



Remove the cover and the crass supports from a lamp shade about 6" high, and you have a wire stand for storing the top of a vacuum-type coffee maker.

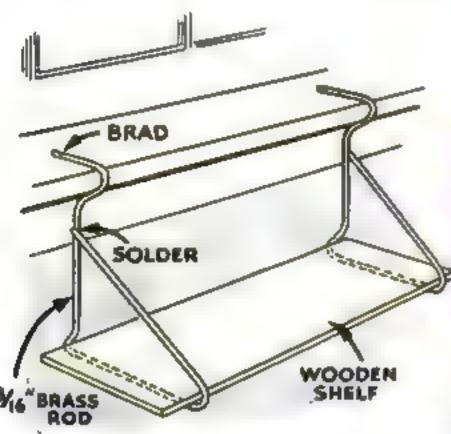


Boots that are damp inside will dry more au chly if a thin board is placed within. Air on the side exposed to greater heat will rise, causing oir flow inside the boot.



Two square clothespins screwed to the inside of your desk drawer will serve as a convenient holder for an envelope containing stamps or for memoranda and documents.

Cut a sleeve from a large shirt, sew it to an old glove, and hang near your furnace or stove. Then, when a fire must be laid, you can place kindling in the deep firebox without sailing your clothing or hands. Pull the sleeve well above your albow.



Brazing rods may be easily shaped to hold a shelf under a window. Bend to the form required and use hard solder on the joints. To attach, flatten the upper ends and drill each for the retaining brads.

Fasten a whitewash brush to an old broom handle with two screws or small bolts, and you'll have a broom that's just the ticket for sweeping the cellar. When it's not in use, stand it on its handle.



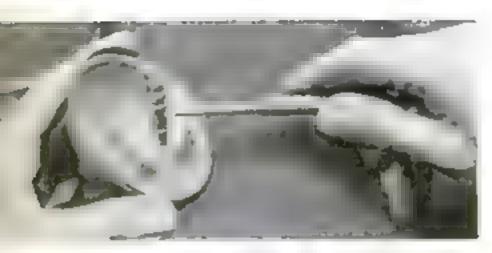






Retrieved in bad condition from the junk closes, these antique pewter teapors again become showp eces.

MENDING YOUR METALWARE



Dents are tapped out with a plastic hammer.



A sandbag supports the potduring hammering. Below, the bottom is carefully soldered on.



By Walter E. Burton

IVE minutes with a soldering iron or a hammer may add five years to the life of a kitchen pan, darkroom tray, or other metalware. Pewter and silver teapots and other antiques or heirlooms can often be restored to their original beauty.

Ordinary soft solder (half tin and half lead) may be used to repair buckets, pans, and similar articles that are not to contain food or be used for cooking, provided the broken places will not be subjected to much stress. Lead may form poisonous compounds and should never touch food.

To solder tinware, simply clean the area around the break, apply a bit of rosin or paste flux, and melt on a drop or two of solder with a hot from or small torch. Tin can often be soldered without flux.

When the metal is untinned sheet iron, clean the area with an abrasive and use an acid flux such as the old stand-by made by dissolving zinc to saturation in muriatic acid. Glazed enamelware such as the popular graniteware can usually be soldered if the glaze is removed to expose a small area of metal around the break. Scrape the metal until it is bright, apply acid flux, and solder. For brass and copper the flux may be any of a number of commercial pastes or rosin. Ordinary solder can be used on aluminum with a special flux, but aluminum solder is better.

A vessel mended with soft solder may be used on a stove without danger of melting the solder provided it is kept filled with enough liquid to cover the solder. But baking utensils or others that must withstand oven heat should not be soft-soldered.

For these and vessels that come into contact

with food or drink, hard-soldering with silver solder or a brazing alloy composed mostly of copper or silver and copper is best. The application of hard solder requires heating to high temperatures and thus isn't always practical, but a hard-soldered repair may sometimes be stronger than the original metal itself. Fluxes are available for each alloy, or borax moistened with water is often used. Ventilation should be good, since fumes from fluxes may be injurious. When a soldering or brazing job is completed, the flux should be washed off thoroughly with hot water.

For hard-soldering, clean the metal around the break and brighten it, apply flux liberally, heat the area with a blow-torch or acetylene torch, and feed in the soldering alloy. The process will repair sheet and cast iron, brass, copper, and, with care, enamelware. Use silver solder for silver articles. When brazing cast Iron,

heat the entire utensil in the kitchen oven beforehand to equalize stress.

Electrolytic action sometimes shortens the life of soft-soldered repairs in photographic trays, but copper, brass, monel, and silver rivets make lasting plugs. Aluminum corrodes in contact with alkalies. Clean out and round the hole in the trav with an awl, remove all rust with a commercial rust remover, dry the area thoroughly, apply a drop of automobile, brushing, or imoleum lacquer, and put in the rivet. For a hole in a tray bottom have the rivet head on the inside and peen down the projecting end to a small dome. Careful riveting will not damage adjacent enamel, and re-enameling can usually be confined to the repaired area.

Riveting without preapplication of lacquer is sufficient for a kitchen utensil, since it does not have to resist strong chemicals. If a riveted repair has a tendency to leak,



Tin plate is an easy material to solder because it is already tinned. Here the handle of a doughout cutter is resoldered. Usually no flux is needed.



Chipped places in graniteware can be kept from wearing through by application of solder. File down to the metal base before making the repair.

Sesides being soldered up, holes can be plugged with rivets or bolts. Selow a rivet put in from the inside is being peened down to a small dome.



Mended spots in enamelware, such as this darkroom tray, are re-enameled even though nonrusting plugs are used. The whole surface need not be redone.



do it over with a new rivet or bolt, using a washer of tinned iron, brass, monel metal, or stainless steel with thin cork under it. The washers go on the inside

For temporary repairs of small holes in containers not used on a stove, rubber "soldering" is a good kink. Melt rubber from an old shoe heel with a soldering iron, force it into the hole so it mushrooms at both ends, and let it set a few hours.

But the peak of household-metal repair is reached in restoring antiques that have enough real or sentimental value to make the extra effort worth while. Dealers are always on the lookout for craftsmen capable of restoring copper kettles, pewter, and silver, and of detinning old brass oil lamps and converting them into electric lamps.

The illustrations show two old wrecks of pewter teapots. One, the straight-sided model in the two pictures at the top of page 174, dates from 1673. Besides dents, it had an unsoldered lid hinge. The other was badly dented, and its sheet-copper bottom was almost completely detached.

Restoration of both present typical problems. You need first of all a sandbag of any heavy sacking, duck, or denim, three-fourths filled with sand and sewed tightly closed. And you need, too, one or more ball-peen hammers and possibly a plastic hammer. The sandbag supports the work and can be maneuvered to various shapes.

Careful tapping can virtually erase dents, but in the case of plated work, they may be so deep that the plating wrinkles slightly. In this case there isn't much you can do except to polish the surface or file or sand off irregularities and have it replated.

The loose copper bottom had a turned-up edge that had been soldered originally to a rim that was badly broken. By careful heating so as not to melt the pewter, the remaining solder was removed and saved. A special pewter solder made by adding bismuth to lead-tin solder to lower the melting point is often used, and it is well to add to it as much of the original solder as can be retrieved.

After the edges of the open bottom were scraped bright, a strip of .005" by %" sheet brass was tinned on one surface and soldered around the opening to form a new rim, with the tinned side out. The bottom was fitted to it by tapping, and it was then heated carefully until the solder on the brass united with it. An acetylene-torch flame is best for this kind of work, and care must be taken to avoid overheating.

Ordinary pasts flux worked well on the pewter hinge of the other teapor. When the lid was resoldered to it, the heat was directed mostly on the hinge because it was of thicker stock.



Bolt-and-washer combinations are handy for quick repairs even in cooking vessels. Kits containing bolts and metal and cork washers are available. The washers are usually put an inside the vessel.



Aluminum pieces such as coffee pots can be mended with ordinary solder if a special flux is used, but aluminum solder is better. Sometimes a small torch is more efficient for heating than an iron.

Below a torch is used for soldering a break in a muffin tin with silver allay. For vessels that hold food or drink, solders containing lead should be avaided. Those with silver or copper are good.



SHOPMADE LEVEL ALIGNS RADIAL HOLES

TRUE radial holes can be drilled in cylindrical and concave stock when a center level like the one shown here is used to align the work on the drill press. A hole is first spotted and prick-punched in the ordinary way. Then the work is set up in the drill press, the level pointer inserted in the punch mark, and the work rotated until the bubble is dead center. If the spindle of the drill press is plumb, accuracy is limited only by the care in spotting the bit and by the trueness of the arc of the work. Do not use the pointer for a punch.

The level can be employed equally well on solid stock and pipe. It is also useful for setting up pulleys and the like in the

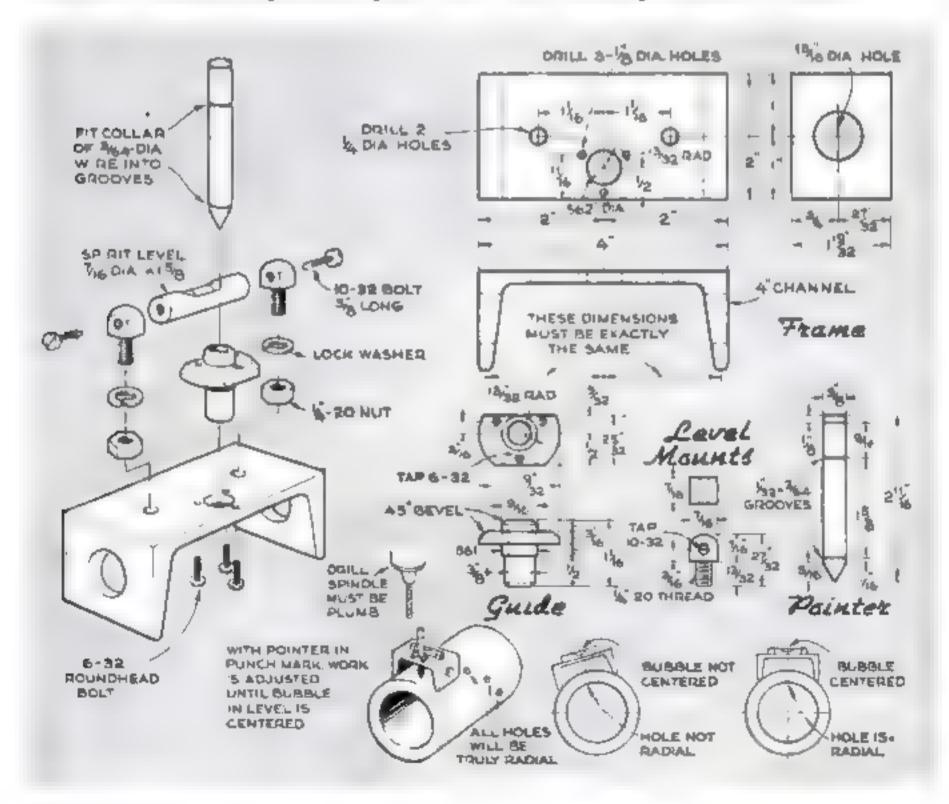
shaper for cutting keyways.

Ordinary 4" channel iron forms the frame and the pointer is turned from %" drill rod. The point should be turned or ground truly concentric with the stem, and it may be hardened. End holes in the frame reduce weight and provide convenient finger holds. A spirit level of the size shown can be purchased as a standard replacement part. The



method of mounting the spirit level on the frame permits easy change in the event it is broken. Two collars of 3/64" diameter wire keep the pointer from slipping out of the guide bushing, in which it should make a good push fit.

All required machining can be done in a 9" bench lathe. The dimensions are given in the drawing.—HENRY J. MIEHLE.



NEW SHOP IDEAS

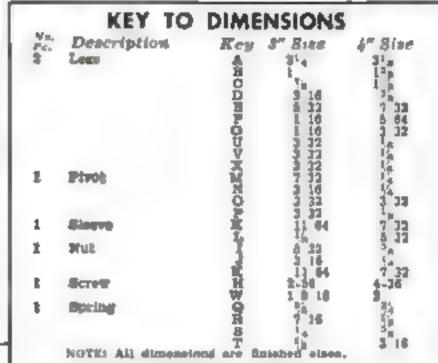


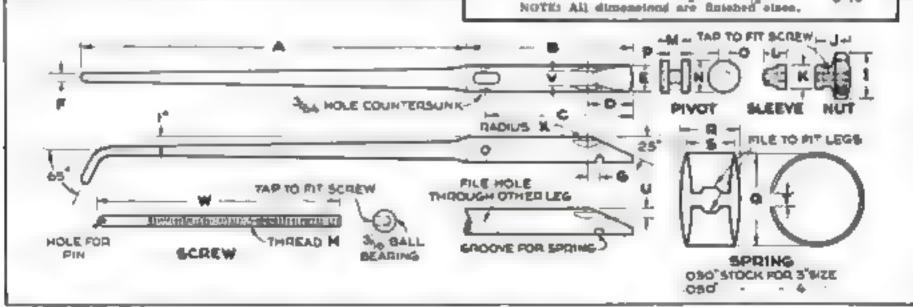
TOOLMAKER'S CALIPERS can be made from scrap material on hand. The two shown are 3" and 4" sizes. Drill rod was used throughout except for the spring, which is flat spring steel, .030" stock for the 3" calipers and .050" for the 4".

Taper the legs to size with a file and emery cloth. This is simpler than turning so small a diameter. Make cuts for the bearing in the drill press with a drill ground flat, if a small end mill is not available. Drill the screw holes and file for clearance.

and cut alots for the spring with a backsaw and file. Countersink the screw-pin holes on both sides so the pin can be peened and filed flush with the legs. Thread the screw, and anneal, drill, and tap a small ball bearing to fit it.

Bend the spring steel on round stock slightly smaller than the finished diameter; then file to shape and polish in the lathe. Twist wire around the spring to keep it from opening, heat to a cherry red, and quench in linseed or lard oil. Run the spring through the flame until the oil begins to burn. Then plunge again in the oil. Don't overheat during this drawing process; instead, draw the spring two or three times to get the right temper.—R. D. JENNINGS, JR.

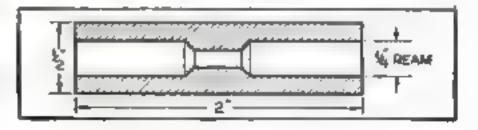


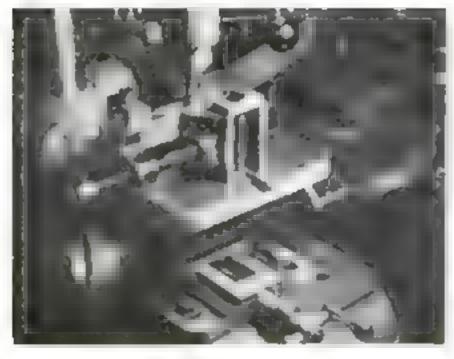


REAMING WITH A DRILL is sometimes necessary, especially when a sleeve like that shown in the drawing is to be made. Here a reamer would be blocked and only its tapered end could enter the hole. With drills, the hole was made a close push fit right to the bottom, the finish being comparable to a reamed one.

Three drills are usually sufficient. They must be accurately and sharply ground and preferably new. The first used should be

5/64" under final size, the second 1/64" undersize, and the last exact size. Run the last two at high speed and slow feed, using lard or cutting oil. On a lathe, center the hole carefully to run true.—A. R. PLAMBACK.



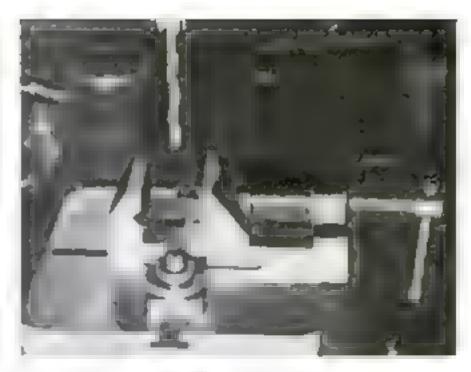


A DRILL-PRESS VISE should be clamped to the table for certain precise drilling and milling operations. With many small vises, however, this cannot be done without placing the clamps on top of the vise bed, where they are likely to restrict the movement of the movable jaw. The drawback can be avoided if slots are milled in both sides of

STANDARD TAPERS can be turned quickly and accurately in the lathe with the compound rest. Chuck a machine reamer or similar tool having the desired taper with the small end toward the tailstock, and make sure the taper runs concentrically. Then mount an indicator in the tool post exactly on center, and adjust the compound rest until the indicator registers zero for the length of the taper. To bore tapered holes, mount the indexing taper with the small end toward the headstock—J. C. M.

ON A WELDING TURNTABLE devised by Sidney L. Gilbert, an employee of the Lameon Corporation, of Syracuse, N. Y., five tons of stacked plates can be rotated by hand to new positions for burning off edges to size. Work on plates too wide for the

to size. Work on plates too wide for the



the vise, as at the left above, to provide suitable surfaces on which the clamps can be tightened.

In the photo at left, the vise is set up in the drill press for end-milling the clamping slots. At right, it is clamped to the table by means of bolts and large washers, ready for use.—J C. MAGEE.



machine had been slowed considerably by the need for using a crane to move them.

The top of the turntable is shown tipped up at left below to reveal the simple revolving mechanism. At right, plates stacked on it are being revolved to another edge.





PIGGY BANK AND PAPERWEIGHT

By C. W. WOODSON

THE SOLE purpose of this metallic porker is to be a safe haven for your spare change until enough accumulates for a savings bond. Another unusual lathe project is the paperweight piglet for your desk.

Hard aluminum alloy is used for the coin bank—a short piece of tubing for the body, scraps of bar stock for the head and tail ends, and plate for the legs and base. The paperweight is made entirely of bronze.

Chuck a 2½" length of 13/16" bronze bar stock and turn the head and shout of the paperweight, as in Fig. 1; then reverse the piece, turn the rear end, and (Fig. 2) drill and tap for a screw to hold the tail.

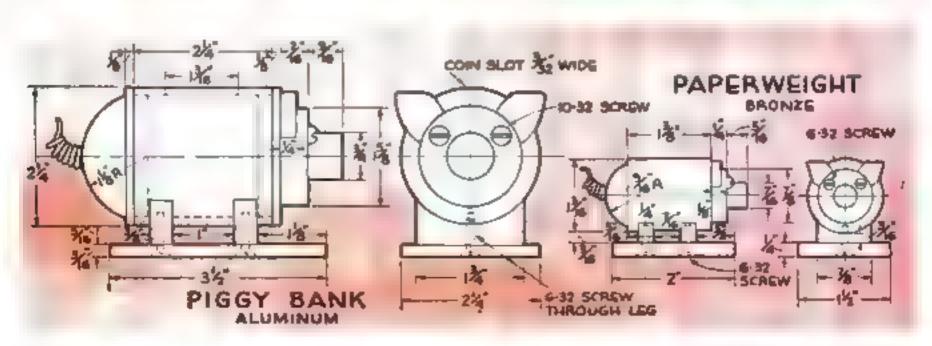
Drill for rivets that hold on the ears; drill

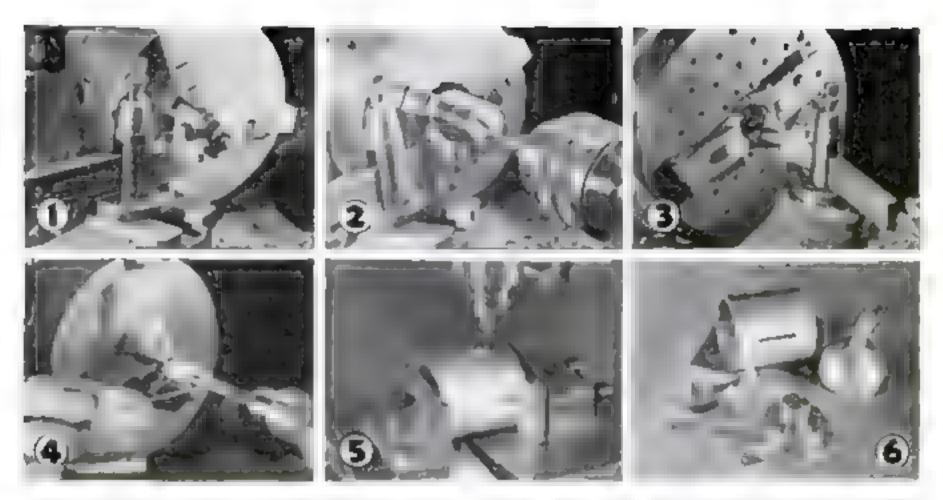
and tap also for fillister-head eye screws.

The legs can be filed, but a neater fit can be had by turning small pieces of scrap to the exact body diameter. Both are mounted on the faceplate, as shown in Fig. 3. Bottom and sides are then filed square. Drill through the legs into the base for mounting screws; then drill and tap the body.

A small spring may be used for the tail, or it may be made up by chucking a mandrel, clamping soft wire under one of the jaws, and winding as in Fig. 4.

Machining of the coin bank is much the same except that the body, head, and rear





end are made in separate pieces. Turn the body to length, square the ends, drill for the coin slot (Fig. 5), and file the slot square. Shoulder the head for a tight fit, but make the rear an easy sliding fit for removal when \$18.75 is banked. A 4-36

screw through the body secures it. The necessity of removing the base first before removing the end may deter unauthorized entry. Bore the %" plate to body diameter and cut out the legs. All parts are shown in Fig. 6.

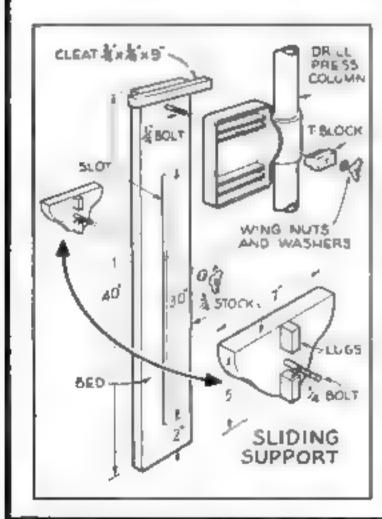
JIG HOLDS STOCK UPRIGHT FOR END DRILLING

MAKING holes in the ends of stock for dowel joints and the like becomes a foolproof operation with the use of a drill-press jig like that shown at right and in the drawing. The slotted board or bed is bolted to the drill-press table, which is tilted to its vertical position. An adjustable slide supports work of any length within the capacity of the machine. This may be up to 40" when

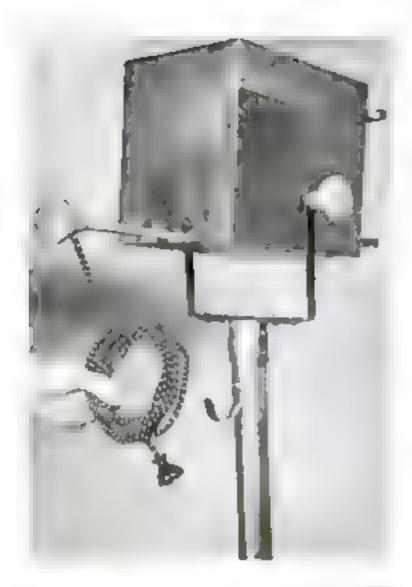
the jig is used on a floor-model drill press.

The sliding support is locked on the bed with a bolt and wing nut through the slot. Lugs on the support rest in the slot to keep the top of the support horizontal. The bed is attached to the drill-press table with a bolt through one table slot, a T-block, a washer, and a wing nut, as shown in the lower photo.

Work can be held by hand if the bit runs true. The table may be tilted at an angle other than the vertical.—FRANK HEGEMEYER.









Homemade Spotlight for Your Photo Studio

By CHARLES and BERTRAM BROWNOLD

OFTEN in portraiture and other photography in which special effects are desired, the concentrated light of a spot is far easier to control than flood-lamp illumination. Such a spotlight for use as an auxiliary or a main light can be made at little cost.

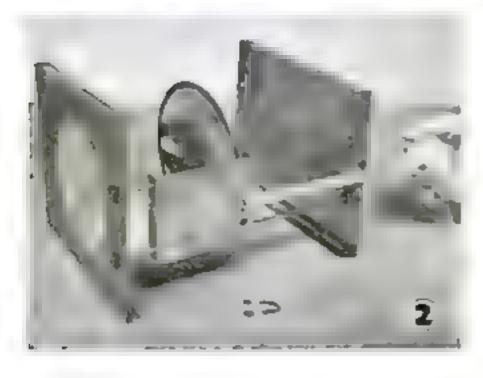
You will need a single plano-convex condenser lens 4½" to 5" in diameter or a Fresnel spotlight lens of the same size. Use with it about a 6" standard spherical photofiash reflector and a 500-watt T-20 projection bulb or projection-type incandescent lamp. More than 500 watts would be dangerous on ordinary house wiring; less would not provide sufficient illumination. Also required are a porcelain screw-in lamp socket with bolt holes, some discarded ferrotype plate or similar sheet metal for the housing, and a stand, which may be obtained at a junk yard or built of wood or pipe.

Determine the focal length of the lens and the point of principal focus of the reflector before beginning construction. The reflector and lamp are mounted on a carriage, as in Fig. 1, and this carriage rides on two rods, as shown in Fig. 2. These rods and the housing must be long enough for the lamp to be moved back from the lens a distance equal to its focal length.

One way of finding the focal length, if it is not known, is by mounting the lens in a temporary holder and moving cardboard back and forth on the flat side until images caught by the lens are projected sharp and clear on the cardboard. The

the nat side until images caught by the lens are projected sharp and clear on the cardboard. The focal length is the distance then measured between the flat side of the lens and the cardboard.

A spherical reflector has its principal focus at half the distance of its radius on a line from its center. This point can be determined by trial and





error, drawing sectors of known radius on cardboard, cutting them out, and fitting them to the concave side of the reflector.

Mount the reflector at one end of the carriage and mount the socket in front of it so that the lamp hisment will be at the point of principal focus and its plane will be at right angles to the reflector radius. Accurate final adjustment can be made if the mounting lug of the reflector and the bolt holes in the floor of the carriage are all slotted. The reflector can then be raised or lowered to center on the filament. and the socket can be moved slightly forward or backward. If the plane of the filament is not at the right angle when the lamp is screwed down to good electrical contact, this may be corrected by carefully prying up the center socket contact.

Threaded ends on the carriage rods will permit holding the front

and back panels with two nuts at each end of the two rods. Cut a circular hole in the front panel '4" less in diameter than the lens, and be sure to locate it so the exact center will be opposite the lamp filament. Place the lens with the flat side toward the lamp and mount it with a rim (Fig. 3) of suitable size cut from a tin can. The rim is held on with six tin-plate clips, formed as shown in the upper left corner of Fig. 6.

Figure 2 shows a tube to receive an asbestos-covered, heat-resistant electric cord for wiring to the socket. The tube is fastened to the bottom of the carriage with a U-bolt. A handle on the end facilitates focal adjustment when the spot is in use.

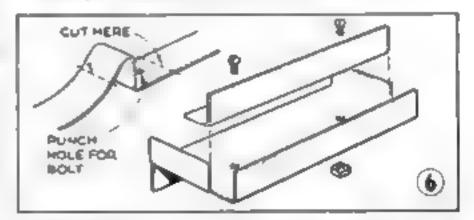
From an old ferrotype plate or other sheet metal bend the top, one side, part of the other side, and half the bottom, as indicated in Fig. 4, where this portion of the housing is shown upside down. Drill ventilation



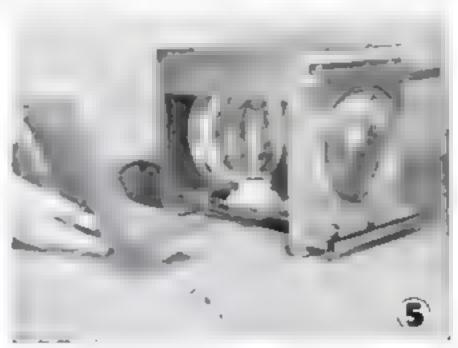
holes in the top and cover them with baffles, as shown. The remaining part of the housing is made from another sheet and is also shown in Fig. 4.

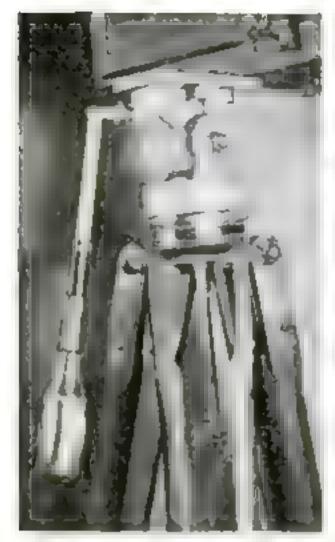
This part can be removed, as in Fig. 5, for changing lamps and the like. Machine screws are used to hold it in place.

Holders for masks and filters may be made as in Fig. 6 and mounted in front of the lens. Obtain or build a suitable stand, and mount the spotlight by means of a U-shaped strap-iron bracket.

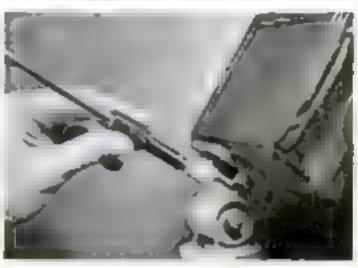


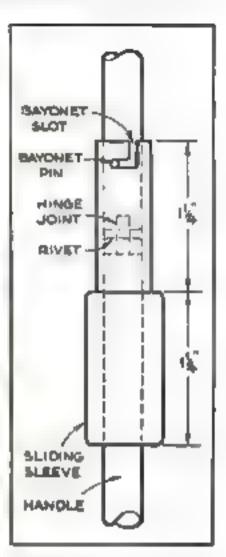












A TRIPOD HANDLE that will fold down out of the way while the tripod is being carried or after its tilting top has been adjusted is a convenience that will delight any photographer.

Saw the original bandle in two about 1" from the tripod head, hinge it as indicated in the photos and drawing, and provide a locking sleeve that will hold the hinge rigid when the handle is used. File, saw, or mill the mating ends for a slot-and-tongue hinge, making sure that the part on the threaded

end is in a vertical position when the handle is tightened to lock the tripod head. Countersink the rivet holes so the rivet heads won't protrude.

Shape the sleeve from metal and drill it to slide easily along the handle without appreciable play. If pipe or tubing fits, it can be used. Knurl the larger end for a grip if it is round or leave square or hexagonal stock the original shape. A grip may be built up on tubing by winding tightly with wire or stout cord.—W. E. B.



ENLARGER EASELS for 5" by 7" and 8" by 10" prints can be made quickly from popular-size picture frames available at all dime stores. Remove the glass and cardboard backing. but leave the mounting nails in one side and end to hold the enlarging paper. The frame shown gives a %" white border.

Focus on ordinary paper; then put the red safe glass under the enlarger lens, insert print paper in the frame, and adjust as indicated by the red image.—H. F. LEEPER.



NONMARRING TRIPOD FEET that won't mark up polished floors and linoleum are made from ordinary white rubber-headed tacks. If the tripod legs do not have holes to receive the tacks, drill them slightly smaller than the tacks. Worn-out rubber feet or sharpened hails that may have formed the feet originally should, of course, be removed with the aid of phers.—ED SHOLANDER.

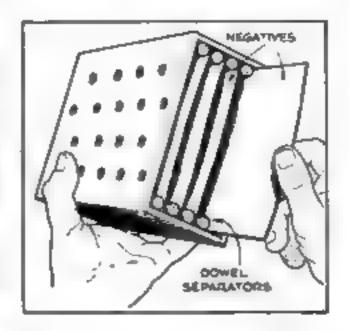
DEVELOPING TANKS for use instead of trays are often improvised by amateurs who do their own developing. They usually use cans, battery cases, and other containers that conform closely to the size of popular negatives and permit the use of a minimum quantity of developer. A negative rack can be made for each container from orange-crate,

cigar-box, or other thin

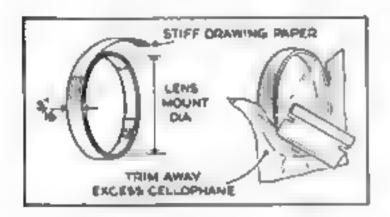
wood,

Build the racks as openend boxes with dowels in the ends as film separators. Perforate the sides to increase circulation, but keep the holes small so the liquid won't force the outer negatives against others during agitation.

Use waterproof glue to assemble, and apply asphaltum paint to protect the wood.—J. MODROCH.







HOMEMADE FILTERS for box cameras and others not readily fitted with commercial filters can be made from yellow, orange, red, and green sheets of cellulose acetate. Make mounting rings, by winding glue-spread strips of drawing paper on a form. Glue colored gelatin to the ring, trim it, and hold it near a flame until it becomes taut. Filters help in obtaining contrasts, showing clouds, and the like.—H. A. Thomas, JR.

GIANT TELEPHOTO LENS DEVELOPED FOR AERIAL PHOTOGRAPHY

WITH twice the focal length of the customary 24" f/6 telephoto lens, a new 48" f/6.3 lens built by Eastman Kodak Company for the Army Air Forces makes objects photographed from a given height appear twice as big. A warming device prevents shrinkage of the mount at low temperatures.

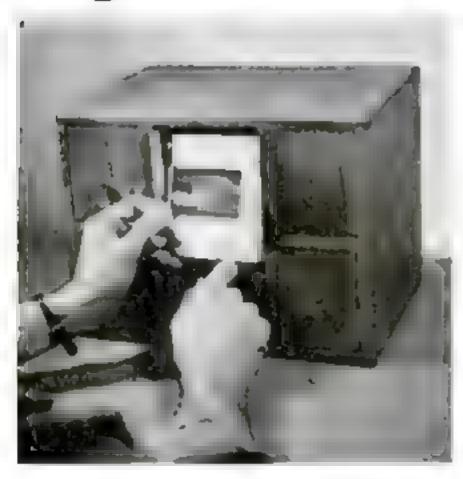
PROJECTOR FOR 2" BY 2" SLIDES



INTERCHANGEABLE f/4.5 and f/4.8 lenses of 3½", 5", and 7½" focal lengths may be used with a slide projector announced by Bell and Howell Company, of Chicago. It uses a 500, 700, or 1,000-watt lamp on ordinary A.C. and D.C. lines. An automatic cooling fan operates constantly when current is on.



Negative File with Built-in Viewer



By FRANK McCARTY

ANY an amateur photographer takes excellent negatives with his camera, develops and prints them, and then—if he is like me—stores them away any old place and promptly loses track of them. When the occasion arises and he wants extra prints or would like to try some new pet scheme of enlarging, he wastes an entire evening thumbing for strayed negatives through old envelopes, desk drawers, the pages of old books, and other odd places.

If he is again like me, he will find a filing cabinet like the one shown here just the place to keep all his negatives in orderly array. The four filing drawers will bold up to 2,000 negatives in alphabetical or other arrangement. And in addition there is a built-in illuminated viewer with an extra drawer for retouching equipment to make it easy to scrutinize and work on negatives the moment they are selected. Occasional use of the viewer provides enough heat to keep the filed negatives dry and to prevent mildew in damp weather.

Make the viewer as a separate unit so it can be pulled out like the drawers and used away from the cabinet if more convenient for retouching. A 5" by 7" sheet of opal or ground glass is fastened to the sloping front by wooden cleats at the top and bottom. The two screws through the top cleat also hold two curved lengths of clock spring with washers to hold negatives down when retouching is being done.

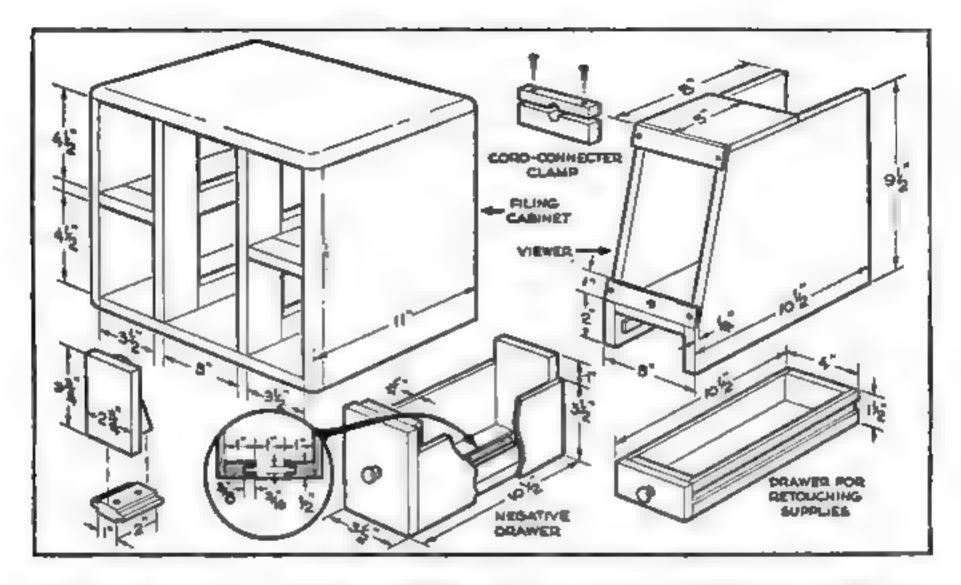
Electrical equipment is standard, consisting of a light socket, cord connector, toggle switch, and convenient length of cord. Half of the connector is clamped in the back of the viewer and wired to the socket through the switch installed at the front. The other half is attached to the cord, which may be plugged in at any house outlet. A 25-watt bulb should provide sufficient illumination

Negatives in glassine envelopes are filed in drawers, as at left. Center, the viewer can be removed for retauching. Electrical equipment includes a standard socket, cord connector, and taggle switch, right.









even when the viewer is used in a brightly lighted room.

In clamping the cord connector in the back of the viewer, first screw down at the back a solid piece of wood and locate the hole through a similar hole in the back of the cabinet so the two will line up and the fixed connector half will project through. The acrewed-down piece is then removed, the hole is bored, and the piece is sawed in half through the hole, as indicated in the drawing. Its lower half is then reinstalled permanently, the connector half put in place, and the top acrewed down as a clamp.

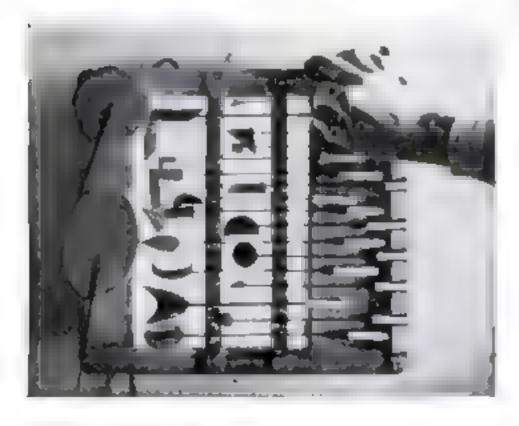
ILLUMINATED RACK SILHOUETTES PHOTOGRAPHIC DODGERS IN DARKROOM

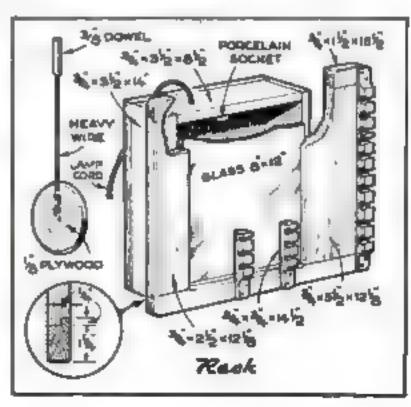
Standing out against a lighted red glass, dodgers are quickly selected from this dark-room rack. The glass, backed with red paper or coated with enamel, is set into a frame carrying three notebed sticks that support the dodgers. It is illuminated by a 10-watt bulb in a box behind it.

Rabbet the frame to take the glass and

rabbet the ends of the sides to fit the horizontal rails. Attach the light box to the frame with an angle iron acrewed to each side, and hang the piece on the wall.

Dodgers may be made of "," plywood beveled at the edges. Bend the ends of wire handles 90 deg., bore and groove the dodgers to receive them, and cement.—E. M. L.





NOVEMBER, 1945

CAN YOU BEAT THESE PICTURES?

We will pay \$5 for any photo used on this page. Write your name and address on each print. Euclose a stamped, selfaddressed envelope and the negative, if it is available, and send your contribution to the Curious Photos Editor.



DENSE FOG IN MANEUVERS at Bristol, England, and the camera tilted upward at an angle provided this shadow shot of two G.L's leaping high over an obstacle. It was taken by Pfc. Jack L. Kincaid with a shutter speed of 1/175th second and a lens aperture of f/3.5.

A CIGARETTE SMOKER'S DREAM. This "city of cigarettes" is a table-top photographic project of Robert Scott, of Saltaburg, Pa. Maybe he could have blown smoke rings for the background clouds, but he used balls of cotton effectively.



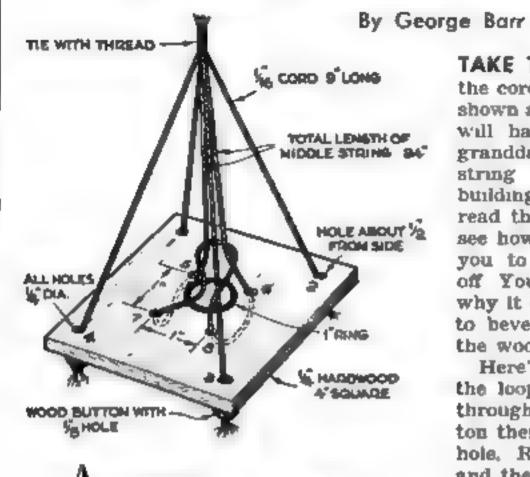


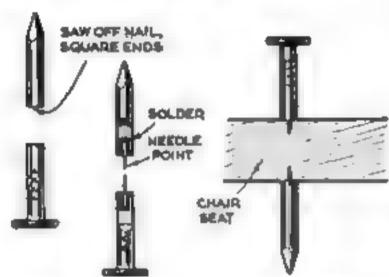
WHEN A TRUCK SITS DOWN, something is bound to happen if anything is in the way. In this instance, the truck was going up a hill and hit a hole in the road. Its dumping mechanism was jarred loose, causing its load of cement to shift toward the back, and upending was the result. The poor car that serves as an unwilling chair was following innocently behind. Dudley E. Barker, of Carmel, N. Y., wasn't driving either the car or the truck. He just happened by in time to snap the photo.



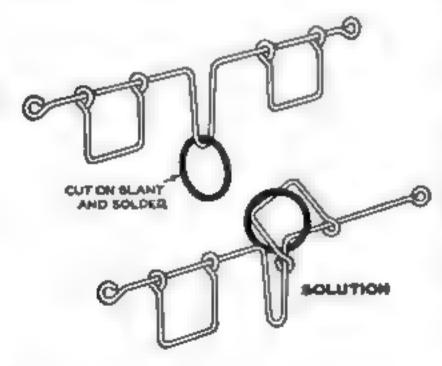
GHOSTS PLAY ON ICE in the photo above. It's of table-top dimensions, though the figures look ominously large, but there's no posing there. Wava Geiger, of Michigan City, Ind., spotted the cerie scene while she was on a Lake Michigan pier. Wind-blown rain and spray froze on short wires, twigs, and other small debris to fashion the weird forms. The foreground is just a sheet of ice, and the bleak and somber background is merely the dull winter sky.

MAGIC YOU CAN MAKE





IF YOU'RE GOOD AT DODGING while you do your explaining, you can try this one with a big nail hacksawed in two, drilled, and fitted with projecting needle points. Stick the needle points in a chair seat or table—not one that needle pricks will harm—and call the owner's attention to the nail "someone has driven through." You also may have to do some dodging after you explain!

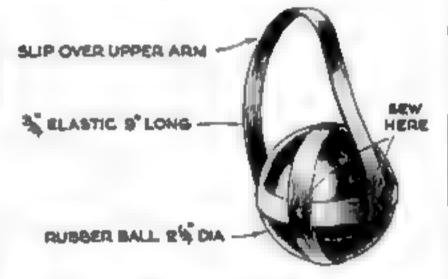


TAKE THE RING off the cord in the puzzle shown at left, and you will have solved the granddaddy of all string puzzles. Try building it before you read the solution and see how long it takes you to get the ring off You'll understand



why it can cause such anguish! Be sure to bevel all holes and shellac and wax the wood.

Here's how the puzzle's worked: Pass the looped end of the long middle cord through hole No. 1, sup it over the button there, and draw it back through the hole. Repeat for holes Nos 2, 3, and 4, and the loop will then be outside all the cords. Don't let the cords tangle.



HALT YOUR PULSE at will and watch your friends—or your doctor—gasp! It's best done with a little showmanship—and a small rubber ball held by a harness under your armpit. Hard pressure does the trick. Inject the showmanship by bringing up the subject of Indian mystics and suspended animation. Assert that you, too, can stop your pulse, and then have someone count it, moving a finger or pencil up and down as he does.

without Benefit Of Pliers or a hacksaw, the ring really can be removed from this curious wire arrangement. As shown at left, it is simply pulled to the top of the V, and one of the stirrups is pushed through it. Make all parts including the ring from stiff coat-hanger wire. Assemble the stirrups on the bar, and then loop the bar ends. Rub the wire smooth with steel wool and wax it well.



The history of the microphone is closely linked to the story of broad-casting. A series of fascinating experiments will show you how radio developed its high-fidelity ears.

By TRACY DIERS

N JUNE 19, 1878, a routine performance of Donizetti's opera "Don Pasquale" was given in the Swiss town of Bellinzona. Neither the date nor the event would be remembered had it not been for a telegraphic engineer named Patocchi.

Patocchi installed a newly invented Hughes microphone on the stage and several Bell telephone receivers in another part of the building. Thus "Don Pasquale" became the first broadcast opera and Patocchi the first studio engineer. There was no sponsor.

Since then science has devoted much effort toward developing a microphone that would reproduce all it heard. You can get an idea of the difficulties if you build and study some experimental "mikes."

Every microphone performs one basic job

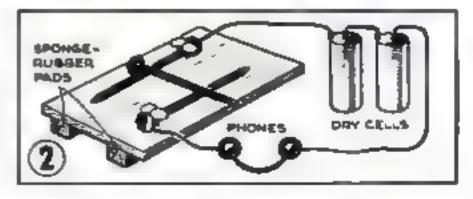
Meet Mr.

—the conversion of sound energy into electrical energy. David Edward Hughes stumbled on his microphone while experimenting with imperfect electrical contacts. You can duplicate his experiment by hooking up three large iron nails as shown in Figs. 1 and 2. Two are tacked down tight on a ¼" by 3" by 5" block of wood and hooked in circuit. The third merely lies across the other two. Small strips of sponge rubber insulate the mike from the table

When there is no sound to strike in waves, a smooth flow of current circulates; but sound waves shake the loose nail, and this varies the resistance of the contacts, interrupting the current flow and causing sound in the headphones.

Low-resistance headphones are best. A long line may be used. By listening to a





Mike

metronome, you can adjust the cross nail until it is in a sensitive spot and reproduces speech understandably.

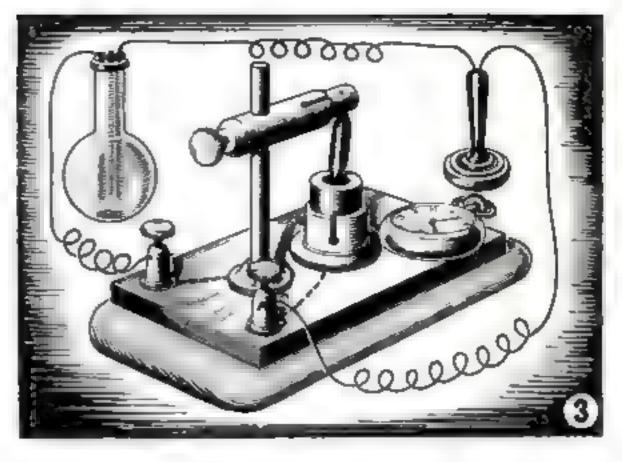
Many unstable-contact microphones were developed. One with a loose carbon rod (Fig. 3) was used for the "Don Pasquale" broadcast. It would be useless in radio. One blast from a symphony orchestra, and you had to readjust it to a sensitive position.

A microphone employing a button containing carbon granules was invented by Edison in 1876. You can make one with a '4" by 5" by 5" wood block having a hole over which you cement a diaphragm from a headphone or a 3" iron diaphragm no thicker than .006". Have the hole 1%" in diameter for a 2%" headphone diaphragm or 2%" for the 3" diaphragm.

Solder No. 30 wire to the diaphragm and solder wire to the top of a metal screw cap from a solvent can or ketchup bottie. Half fill the cap, or "button," with microphone-carbon granules or crushed battery carbon and cement it to the diaphragm with a paper washer under it for insulation, as in Fig. 4. The hookup is shown in Fig. 5.

Normally current flows smoothly through the carbon and headphone, but the pressure of sound waves on the diaphragm presses and releases the granules, changing resistance and the current flow to the headphone and thus producing sound.

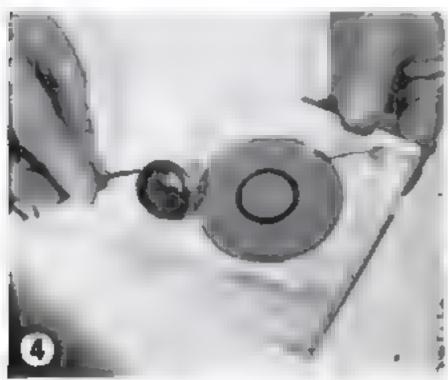
There are disadvantages, as you will find if you listen to the continuous hiss of the

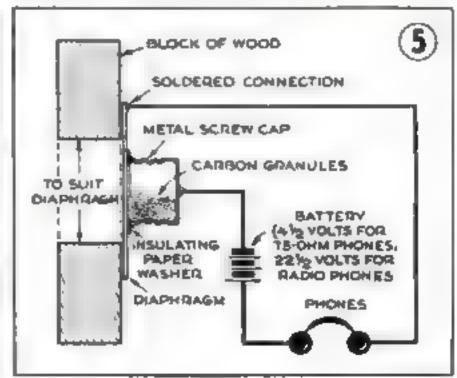


granules in a quiet room. Note, too, how they react to different letters in the alphabet. Such a mike is erratic at various frequencies and is hardly of high fidelity. Held in different positions, it varies in sensitivity, and frequently its granules pack. But in spite of drawbacks, the carbon mike has reached a good stage of development in telephones, walkie-talkies, and tank and plane radios.

The double-button carbon mike, having buttons on opposite sides of the diaphragm, saw us through the early days of broadcasting. It was connected through a center-tapped input transformer. Finally the demand for a higher-fidelity mike tough enough to stand a little manhandling resulted in the condenser microphone. And from it radio got its first high-fidelity ears.

You can build a condenser mike from scrap items. Cut a 2½" diameter hole in a ½" by 5" by 5" piece of wood and sand one face smooth. Cover the hole on the sanded face with a 4" square of thin tin foil or aluminum foil, as in Fig. 6, inserting a 6" length of No. 30 wire under the foil for a

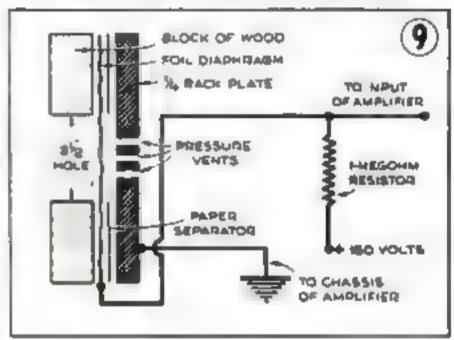












connection. Cut a 2½" hole in a thin sheet of paper 5" square, lay it on the foil, and put on top of that an absolutely flat ½" by 5" sheet of aluminum or brass in which two or three ½" holes have been drilled near the center. Clamp the pieces, as in Fig. 7, and the mike is ready for action (Fig. 8). The wiring diagram is shown in Fig. 9.

Since the output will be too low for headphones, connect the condenser mike directly to an amplifier by means of the ungrounded mike lead. The phonograph input of a radio may be used if it has sufficient stages of amplification, but a high-gain audio amplifier is more satisfactory.

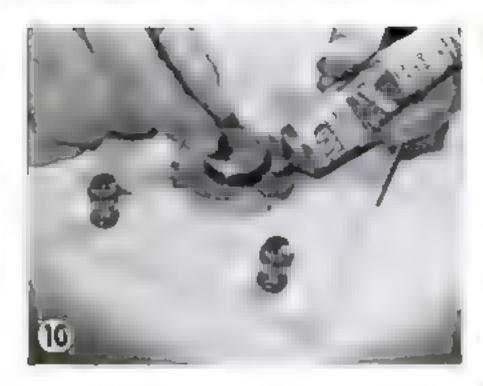
The required 180 volts for charging the mike is obtained with least hum from separate batteries. If voltage must be taken from the amplifier power supply itself, tap the voltage divider at the 180-volt point or, if there is no divider, tap at the filtered high-voltage point with a resistance in series to drop the voltage to 180. A separate small B eliminator can also be used. The foil diaphragm and backplate act as the plates of a condenser. Pressure from sound waves moves the diaphragm and changes the capacity of the condenser, producing across the 1-megohm resistor a voltage that is fed into the grid of the first amplifying stage.

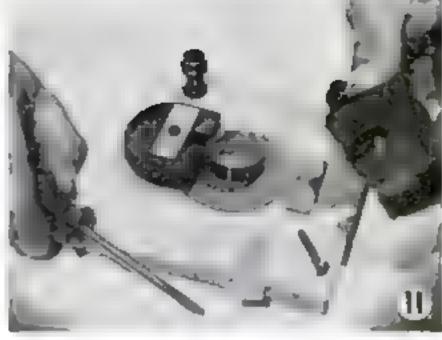
Condenser mikes were essential to radio and talkles for years. Their chief disadvantage was the need of a small amplifier tagging along or in the same case. Then a fact that had been known for 100 years was utilized to make a microphone that was light in weight, was high in fidelity, and could be separated from the amplifier—the dynamic mike.

You can build a moving-coil dynamic microphone on a ½" by 5" by 5" block of wood having a hole 2½" in diameter. Cement a very thin iron or mica diaphragm over the hole, and then to the center of the diaphragm cement a voice coil. Use a coil from an old dynamic speaker or make one with No. 36 enameled wire wound in one layer for ¾" around the circumference of a light paper form 1" in diameter. Bring out the ends of the wire to the terminals on the board (Fig. 10).

Use two small permanent horseshoe magnets to surround the coil with a strong magnetic field, attaching each with a screw passed through '4" wood shims, as in Fig 11, so that the magnet does not touch the diaphragm. Opposite poles face each other so the field flows through the coil

An amplifier makes audible the sounds picked up. But since the impedance (A.C. resistance) of the voice coil is very low,





couple the mike to the amplifier through a matching transformer, such as a push-pull output transformer, as shown in Fig. 12. When sound waves strike the diaphragm, the coil moves in the magnetic field. A tiny voltage is thus induced in the coil and flows into the transformer. A secondary voltage is induced in the other side of the transformer, and this enters the amplifier.

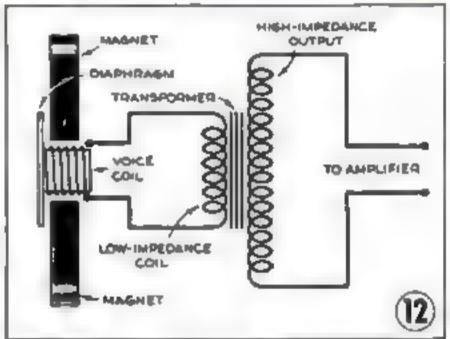
Modern dynamic mikes reproduce sounds ranging from 35 to 10,000 cycles per second and are still widely used.

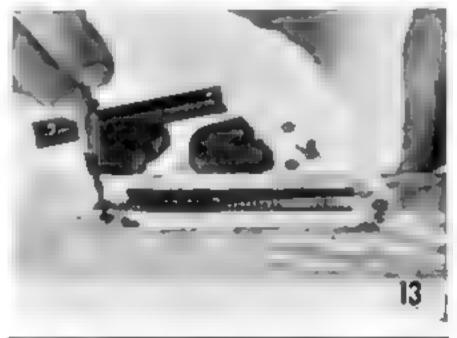
Another type, a ribbon or velocity mike, is operated by changes in the velocity of the surrounding air instead of by pressure. In contrast to the diaphragm, which tends to resist sound waves, the ribbon is so light it bobs up and down as the waves approach and offers so little resistance that they pass on unaltered.

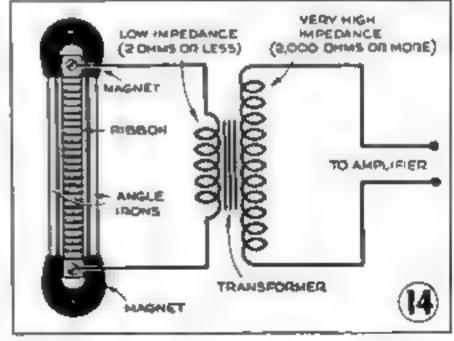
To make a ribbon microphone, cut a 7/16" by 4%" slot in a %" by 3" by 9" piece of plywood and screw a %" by 4%" angle iron at each edge of the slot. The ribbon may be very thin aluminum foll—the thinner the better. Cut a strip %" wide and 5%" in length and corrugate it by pressing it against a piece of corrugated cardboard. Then suspend it over the slot by a screw at each end, as shown in Fig. 13. Place horse-shoe magnets at the ends with polarities arranged for attraction. Connections to the ribbon are made through the screws.

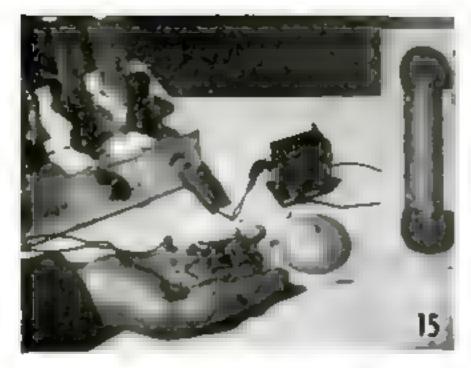
Hook a transformer between the mike and amplifier (Fig. 14). Any transformer having 2 ohms or less impedance on one side and 2,000 ohms or more on the other works well. Turn the amplifier gain up high and test the mike. The velocity of sounds in the vicinity starts a slight motion in the ribbon, and since the motion is in a strong field, voltage is generated and current flows to the transformer.

Your ribbon mike will work whether you speak in front of or behind it, but if you move a sound producer such as a music box or bell around it, as in Fig. 15, you will

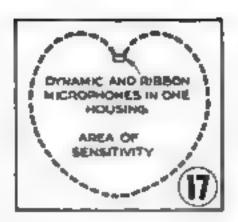














find spots of greater and less sensitivity. Figure 16 shows the field of sensitivity of a typical ribbon mike.

If you could cut off one of the loops in Fig. 16, you would have a directional mike that would "select" sound from a given area. This is done with a cardioid mike (named for the shape of the field, as shown in Fig. 17) which usually combines in one housing a ribbon mike and a dynamic mike, the latter "phased" to cancel one loop. Opera is broadcast by such a cardioid mike with the live side facing the performers.

A very new addition is the crystal mike, depending for its operation on what is known as the piezoelectric effect. When a crystal held between metal plates vibrates under slight pressure, a measurable voltage is produced in it. You can make the active element, a crystal sound cell.

Make a supersaturated solution by dissolving 6 oz. Rochelle salt in 4 oz. water at about 200 deg. F. As the solution cools slowly, crystals about ¼" long form. When one resembles that in Fig. 18, remove it and let it dry. This is your seed crystal.

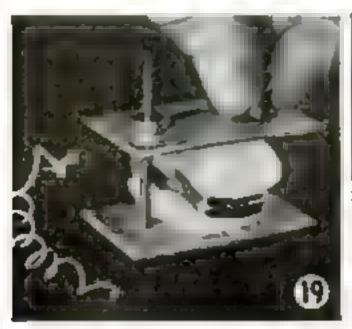
Bring 16 oz. water to the boiling point, dissolve in it as much Rochelle salt as can be held in solution, and let it cool slowly, being sure to keep out dust. Then hang the seed crystal in the solution on a thread. Growth takes place in a few hours. Remove

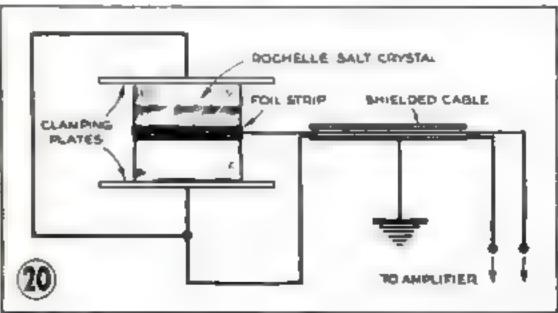
the crystal when it measures about 1" in any direction, and put it in alcohol for 24 bours. If your first attempt doesn't turn out well, try again.

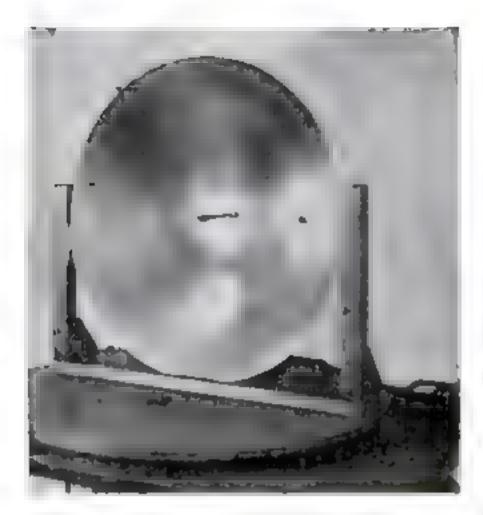
Make a sound cell by wrapping a ¼" strip of tin foil around a perimeter of the crystal and clamping any two opposite surfaces between two metal plates, as in Fig. 19; then hook the cell to the amplifier as shown in Fig. 20. Move the crystal to a different position in the holder if it doesn't show good sensitivity at first.

There are two types of crystal mikes. In one, two small plates of Rochelle sait are cemented together to make a "bimorph" unit of extreme fidelity that will respond to from 30 to 20,000 cycles a second. The pressure of sound waves causes the flat crystal plates to generate voltage. A more popular, cheaper type has a diaphragm connected to a light driving rod that transmits the pressures to the bimorph unit.

"Don Pasquale" is still very much alive, but the methods of broadcasting it have changed greatly. Instead of simple rods delicately adjusted, we now have slick chromium-plated cardioid mikes with directional selectivity and high fidelity. Such innovations as frequency modulation have put Mr. Mike on the spot, but moving coils, vibrating ribbons, and sensitive crystals have met the challenge.







radio ideas



ODD ANTICS OF MICROWAVES, those tiny electromagnetic waves sandwiched between broadcast frequencies and heat and light, are demonstrated at the Polytechnic Institute of Brooklyn with equipment like that in the photos above and at right. Transmission is from antennas 1" to 2" high.

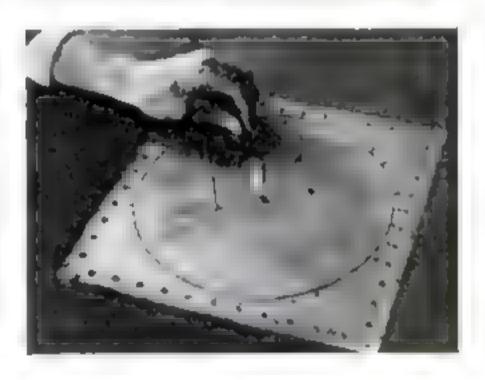
Radarlike action is shown by beaming microwaves across an auditorium from a parabolic reflector to a sheet of metal off which they bounce to be picked up by a receiver. They can also be deflected by a hand in the path of the beam.

Microwaves can be passed through 24' of 4" tubing with practically undiminished power even when there is an elbow joint in the pipe. If a length of 1%" tubing is added, no signal will come through, unless the narrower section is filled with a paraffin rod. Microwaves can also be shown to be capable of polarization like light waves.

LACQUER PROTECTS RADIOS and other communication equipment in the tropics from moisture condensation and fungua. Such parts as open electric contacts, relays, variable capacitors, and selenium rectifiers, on which the protective coating would affect operation, are masked by paper, cloth, and metal jigs after the equipment has first been thoroughly cleaned. The equipment is then baked to remove moisture in an infrared-lamp plywood cabinet developed by the U.S. Signal Corps at the Holabird Signal Depot. A special lacquer or special varnish is next applied by brushing, dipping, or spraying with two coats, care being taken to cover all unmasked

parts, and the masking is then removed.

Microwave radio signals are beamed by a parabolic reflector, left above. The source of the signals is the tiny antenna in front. A horn, just above, receives microwave signals and has an adjustable tuning mechanism. Below, miniature antennas used to study the radiation patters of antenna groups. Broadcast directions can be determined with them.





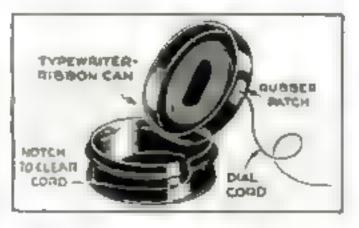




WEAK RADIO TUBES often show new signs of life when subjected to the healing effects of heat. You may have noticed that tubes that were relegated to the spare-parts shelf for a "rest" worked perfectly a year or so later. Heat merely speeds up this self-healing process. To reactivate tubes having no defects other than low electron emission, place them in a tray or shallow pan and bake them for four to five hours in an oven that is kept between 350 and 400 deg. F. Allow the tubes to cool in the oven, and test them after they are cool. Some tubes will show no improvement until they have been in operation for a few hours. The process is usable only on tubes with oxide-coated cathodes, but this class embraces practically all modern receiving tubes. No tube can be successfully reactivated more than once, so those so treated should be plainly marked.—W. H. BLANKMEYER.

SPAGHETTI with nail-polish "sauce" doesn't make a very appetizing dish, but your radio won't be able to tell the difference. If you have trouble obtaining spaghetti tubing, use ordinary sode-pop straws. After fitting the straw around the wire, cover it with nail polish or shellac. Be sure to apply the latter generously around the ends to prevent slipping.





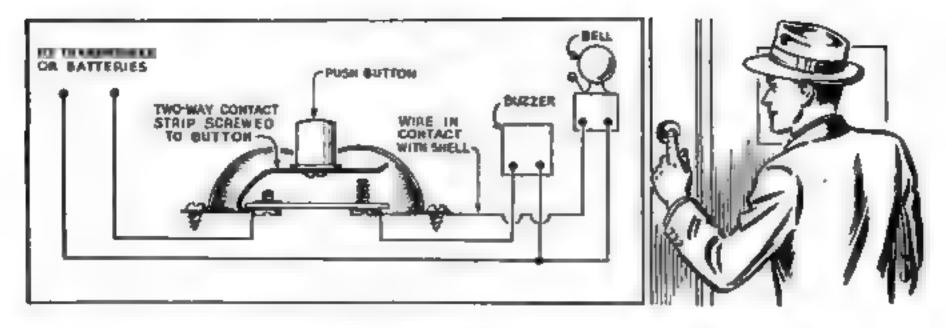
DIAL CORD won't snarl up in a serviceman's kit if it is carried in a dispenser such as that shown above. Drill a hole about %" diameter in the upper part of a typewriter-ribbon can and cut a corresponding notch in the lower piece. Cement a small rubber patch over the hole, and when the coment has dried, punch a pinhole and draw the cord through. The patch acts to prevent the cord from slipping back inside.—R. P. TURNER.

FROZEN MUSIC used to be a constant cold-weather problem because our automatic phonograph, located next to an outside wall, refused to warm up.

We gave our sluggish turntable a boost by mounting a 5,000-ohm reaistor in a space between the motor and recordchanger mechanism. A separate cord and plug assembly, which can be removed in the spring, connects with the 115-volt line. The heat dissipated by the resistor keeps the phonograph at operating temperature. Power consumption, even under continuous operation, is less than two kilowatt-hours a month.-W. ALLPHIN.



BURNED FINGERS sometimes result when tubes that have become uncomfortably hot are removed or switched around. Rectifiers, power-output tubes. and high-current television amplifiers such as the 6AC7 shown often dissipate enough watts to become painful to the touch. A pair of rubber fingertips of the sort used by many bank tellers will protect your fingers against heat, and will provide a safe and sure grip on the tube as well.-G. S.



TWO-WAY PUSH BUTTON ON DOORBELL IDENTIFIES YOUR CALLERS

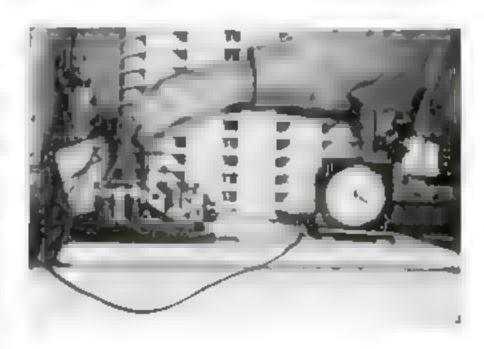
IF THERE are times when you'd rather not answer the door to casual callers or salesmen, but don't want to miss a visit from a friend, try this novel doorbell circuit. When the button is pushed, it rings the usual signal. But those you let in on the secret will pull the button, sounding a special bell or buzzer and so identifying themselves.

The push button must have a metal shell. Its button must be of an insulating material. Drill a hole in the spring contact and acrew the button to it. Bend the contact to the shape shown in the drawing. Connect the lead from the current source to the spring, and the one from the extra bell or buzzer to the outer shell.—WILLIAM RIEDERICH.

CLOCK WIRED TO REFRIGERATOR RECORDS RUNNING TIME

Have you ever wanted to know how long your refrigerator or oil burner runs in a day? A self-starting electric clock will tell you.

Take the cover off the control switch, connect one clock lead with an insulated clip to the terminal on the load side of the switch, and connect the other to the unbroken side of the incoming line. Whatever time lapse the clock indicates will be the total time the mechanism ran.—H. F. L.



METAL CLIP FROM COFFEE BAG KEEPS WIRE COILED NEATLY

LONG coils of wire or lamp extension cord can be held neatly in place and kept from kinking by the use of one or more simple clips as shown above. The metal closing strips attached to the tops of coffee bags are excellent for the purpose.—H. K.

SPARE BULB CAN BE CARRIED IN FLASHLIGHT END CAP

WHEN a flashlight must be depended on, it is wise to have a spare bulb handy in case one burns out. An extra bulb, wrapped in paper and cord to prevent breakage, can be held under the end-cap spring.—H. F. L.





Dip cotton and wool into sodium hydroxide, above left," and the wool disappears; put similar strips into sulphuric acid, and the cotton is eaten away. Below, chemicals which remove spots by acidation.



Drop a little acetane on acetate rayon, and below is what happens. The rayon dissolves!



Spot

A TASK FOR THE

By KENNETH M. SWEZEY

NLY a few years ago, when all cloth consisted of natural fibers colored with natural dyes, cleaning was chiefly a matter of sufficient soap and water, backed up by clow grease; and spots were attacked with rule-of-thumb measures, often generations old.

Today, however, an ever-widening array of rayons, nylons, and other synthetic fibers, and man-made dyes of every imaginable hue and chemical composition, have raised textile cleaning to a scientific industry. Organic solvents have taken the place of soap and water on many fabrics. Workers in spot-removal rooms of the bigger cleaning plants have become textile experts and chemists.

Several organizations of cleaners and dyers maintain laboratories where scientists are searching constantly for better methods of cleaning fabrics. The processes and procedures they have evolved are recorded in a series of excellent manuals.

Although you would need one of these books, plus considerable experience, to handle many of the problems that confront the professional cleaner, you can begin exploring this subject by using only the chemicals that you probably already have on hand.

Before treating textiles with chemicals, however, you should first learn what the common ones can and cannot tolerate.

A simple experiment will show the general reaction of vegetable and animal fibers to mineral acids and strong alkalies. Vege-

 Dye-spotted, a white cloth is about to be cleaned by dipping into a potassium permanganate solution.



Removal

CHEMIST IN YOUR FAMILY



table fibers include cotton, linen, and ordinary regenerated cellulose rayon. Animal fibers include wool, silk, and hair.

Suspend strips of cotton and woolen cloth beside each other in a glass containing a 10-percent solution of sodium hydroxide, and hang a similar pair of strips in a warm solution of dilute sulphuric acid. Examine the strips after half an hour. You will find that the sodium hydroxide has disintegrated the wool, while the acid has eaten away, or at least badly weakened, the cotton. The other strips of wool and cotton are scarcely affected by the solutions.

Here, then, is striking proof that woolens never should be placed in water containing strongly alkaline washing powders (made up of such constituents as sodium carbonate and trisodium phosphate) and why mineral acids should be kept well away from cotton fabrics.

Acetone is an excellent solvent for paints and lacquers on almost all textile materials, but cleaning chemists will warn you never to use it on acetate rayon, or celanese. Put acetone on this variety of rayon—and that's the end of the rayon. It dissolves in this liquid as readily as sugar does in water. You can easily identify acetate rayon by burning the end of a small sample. It melts as it burns, leaving a hard, easily recognized knob of ash.

Colored textiles admittedly are the most difficult to tamper with, for a solvent or a bleach that will remove a stain on such material may often remove or alter the color of the original dye as well.

One form of coloration change in a dyed

material comes from an alteration in the chemical nature of the dye. Basic dyes, for instance, often change color when touched with a weak acid such as might derive from fruit juice or fresh perspiration.

A red basic dyestuff, known as "Congo red," gives a startling example. Touched with acid, this red dye turns a vivid blue.

This often occurs, and the owner of the affected garment throws it away. But there is no need to do so, for the color can be changed back to red merely by rinsing out the acid and neutralizing the spot with a weak alkali, one commonly used for this purpose being ammonia.

Acid dyes that have changed color by contact with alkalies often can be restored in a similar manner by rinsing and treating with 28-percent acetic acid. Provided that they do not affect the dye, acetic acid and ammonia (as a weak acid and alkali respectively) may be used on virtually all textile materials.

Spots or stains on white material generally are removed by employing one or all of the following three methods:

- 1. Solution in a solvent.
- Absorption of a fresh stain by a finely powdered substance.
 - 3. A reaction which bleaches the stain.

In selecting a solvent, a knowledge of chemistry is highly important. To pick the right one you must know not only the nature of the spot but what chemical agent will dissolve it.

Plain water will wash out such things as blood, sugar, and animal glue. Greases and other substances such as candle wax, chew-

2 However, the solution colors the cloth a deep purple, making it appear completely hopeless. 3 But rinse the cloth, dip into axalic acid, and it's snow white again! Oxidation did the job.







On fresh stains, absorption with the aid of a dry powder frequently makes cleaning easier. Ordinary precipitated chalk is excellent for this purpose.



Tobacco stains can be removed from the fingers by swabbing with a two percent solution of potassium permanganate, then a sodium bisulphite solution.

ing gum, adhesive tape, and shoe polish require an organic solvent. Carbon tetrachloride and benzol are two such solvents. Remember that benzol is highly inflammable. Carbon tetrachloride, however, does not burn at all, and, because of this quality, is one of the most common of the fluids employed in dry cleaning.

Paint varies in its composition, but cleaning chemists have developed a formula for what they call a general paint remover. It consists of equal parts of benzol, carbon tetrachloride, and amyl acetate (banana oil). The first two ingredients remove ordinary paints, while the last takes care of lacquers. If the amyl acetate is pure, this formula may be used for all textiles. Impure amyl acetate may damage acetate rayon.

Absorption often may be used effectively on fresh stains, reducing the color and making final cleaning easier. This procedure consists of moistening the spot with water and spreading a powder over it. Part of the material causing the stain then is absorbed by the powder. Precipitated chalk is excellent for this purpose.

Reactions which bleach stains either give oxygen to the compound causing the stain or take oxygen from it. In either case the compound is changed from a colored to a colorless one.

Ordinary hydrogen peroxide and sodium hypochlorite (Javelle water, Chlorox, and the like) are the most common of the oxidizing bleaches now used. Stains from fruit juices, coffee, tea, and slight scorching generally respond to bleaching with peroxide of the three percent drugstore variety.

Sodium hypochlorite solution is much faster than hydrogen peroxide, but it should be used only on cotton, linen, or synthetic cellulose fibers. A little acetic acid added to the solution will make sodium hypochlorite work even faster by liberating chlorine. When sodium hypochlorite is used the area later should be treated with an "anti-chlor," or chlorine remover. This can be a solution of sodium bisulphite, acetic acid, or ordinary photographic hypo.

As previously stated, sodium hypochlorite is a faster oxidizing agent than hydrogen peroxide. You can determine their relative speeds by adding a little to separate containers of dilute ink or dye and timing the reaction.

Potassium permanganate, however, is by far the strongest and fastest of the oxidizing agents—so strong and fast, in fact, that it is rarely used except on the most obstinate spots. Strangely enough, the one or two-percent solution employed for bleaching is a deep purple color, often far more conspicuous than the spot it helps to remove.

Pour a little of the solution into a shallow container, such as a saucer, and immerse in it a bit of white cloth spotted with ink or dye. Remove the cloth after a few seconds—and it is all stained purple. If you now dip the cloth in a 10-percent solution of oxalic acid (poison!) or of sodium bisulphite, however, both the permanganate and the original stain will disappear. The cloth is left whiter than before.

Sodium bisulphite or oxalic acid sometimes is used alone to remove the color from stains, for each acts as a reducing agent a substance which robs oxygen from the colored compound. If cleaners find they can't remove a stain by oxidizing it, they try reducing it. Between the two, the stain generally disappears.

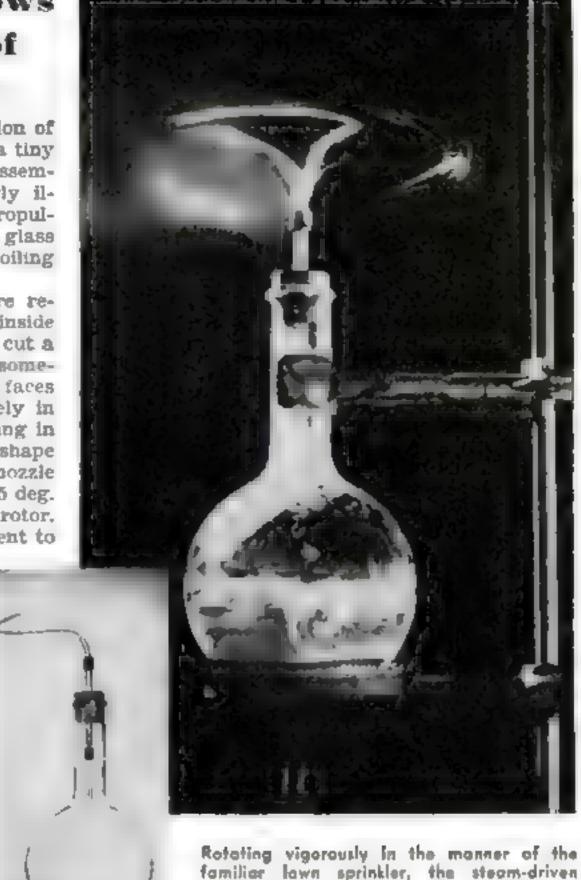
Glass Motor Shows the Principle of Jet Propulsion

Whirled rapidly by the reaction of steam pouring vigorously from a tiny nozzle, the rotor of this easily assembled laboratory device strikingly illustrates the principle of jet propulsion. The rotor is formed from glass tubing. Steam is produced by boiling water in the flask.

Two sizes of glass tubing are required, one of which will just fit inside the other. From the larger size cut a piece long enough to project somewhat beyond the top and bottom faces of a rubber stopper fitted loosely in the flask. Heat the smaller tubing in a Bunsen burner and bend it the shape shown for the rotor. The nozzle should form an angle of about 45 deg. with the horizontal arm of the rotor. It may be necessary to experiment to

get the size of the drawnout nozzle just right.

Cut two washers from rubber connector tubing and adjust them on the straight portion of the rotor so they hold it in place in the larger tubing or bushing. Allow a total play of about %" between the washers and the ends of the alceve. It is best to support the flask at the neck, for otherwise the whirling rotor may overturn it. For safety, keep the flame low in order to generate steam slowly .- MARTIN MEYER.



WASHER S'17' BOARD

EXTRA RING STANDS FOR YOUR HOME LABORATORY

davice above illustrates the principle of

jet propulsion. At the left, note how the

rotor was bent to shape from glass tubing.

SERVICEABLE ring stands can be constructed with wooden bases and uprights of %" iron or steel rods. Solid curtain rods will do. The stands will be strong enough for most purposes, and if the base is weighted, will serve as well as the usual east-iron variety.

For the base, a 5" by 714" block cut from 1" stock is a good size. At a point 1" from one end and midway between the sides of the block drill a hole 1" in diameter and 14" deep. Then drill a 14" hole the rest of the way through. Sandpaper all faces and apply an acidproof varnish.

Cut %" rod or %" pipe 19" long, thread one end for a distance of %", and turn a tight-fitting washer up over the threads until it binds. The washer will serve as a collar on top of the base. Thrust the threaded end down through the %" hole and secure with a nut.—JOHN VAINE.

Experiments show strange

INDOORS, on a dry winter day, it is difficult to move without being conscious of the presence of static electricity. When you comb your bair, tiny sparks crackle from the comb. Shuffle across a thick rug, and a spark shoots from the tip of your finger to the first grounded object you approach. Rub paper with the side of a pencil, and the paper will stick to a wall.

Static electricity was observed as long ago as 600 B.C. The Greek philosopher Thales rubbed amber with wool or fur and found it then would pick up small bits of thread, cloth, dry wood, and other materials. From the Greek name elektron meaning amber, Dr. William Gilbert deviced the word electric 20 centuries later.









COMB YOUR HAIR BRISKLY, and you can pick up bits of paper with the charged comb, as you probably know. This is a duplication of the experiment of Thales, the earliest electrical experiment on record. But from that introduction to static electricity, you can go on to startling feats.

LIGHTING A FLUORESCENT TUBE by hand is one such trick. Shuffle your feet on a rug, hold one end of the tube and touch the other to some grounded object or another person, and the tube will emit a bright flash. Keep the tube in contact with your ground and continue shuffling, and it will flash periodically as voltage is built up.

THE ELECTROPHORUS, a device invented by Volta about 1775, affords an easy method of producing static electricity. Make a plate of hard rubber, sealing wax, or sulphur—you can melt powdered sulphur in a coffee can lid over a low frame, smoothing it with fine sandpaper when it hardens. Then attach a sealing-wax handle to a jar friction top, as in the lower photos.

Charge the sulphur plate negatively by rubbing with fur or wool, and then place the jar cover on it. Electrons will be driven from the lower to the upper side of the cover by repulsion, producing a negative charge on the upper side and a positive on the lower. They neutralize each other when the cover is removed; but touch the cover first with a finger, and electrons will be taken off, leaving the cover positive. This can be repeated several times without again rubbing the sulphur plate.

To show that the electrical energy in the cover comes from the work done in lifting, attach a spring scale to the handle. The spring stretches but little when the cover is lifted without being touched first by a finger; it stretches more when touching produces a positive charge.

ANTICS OF STATIC ELECTRICITY





TIN FOIL WILL FLY when it comes in contact with a charged electrophorus. Bits of tissue paper will cling first, then stand on edge, and finally fly off. Both foil and paper when dropped on the positively charged cover are attracted first, and then repelled as they also receive a positive charge. Paper takes longer, being a nonconductor. An interesting toy can be made by shaping foil and paper as tiny planes, rocket bombs, and insects or other lifetike little figures.

ROTATING IN A JUG, a suspended straw will follow your finger if you first take on a static charge by rubbing your feet on the carpet. Be sure the glass jug is perfectly dry by leaving it open in a warm place for some time before using it. Suspend a short straw by a single strand twisted from a silk or cotton thread, as shown below. Move the finger around the jug without touching it. This will mystify friends who can't do the trick, if you don't lead up to it with other demonstrations.

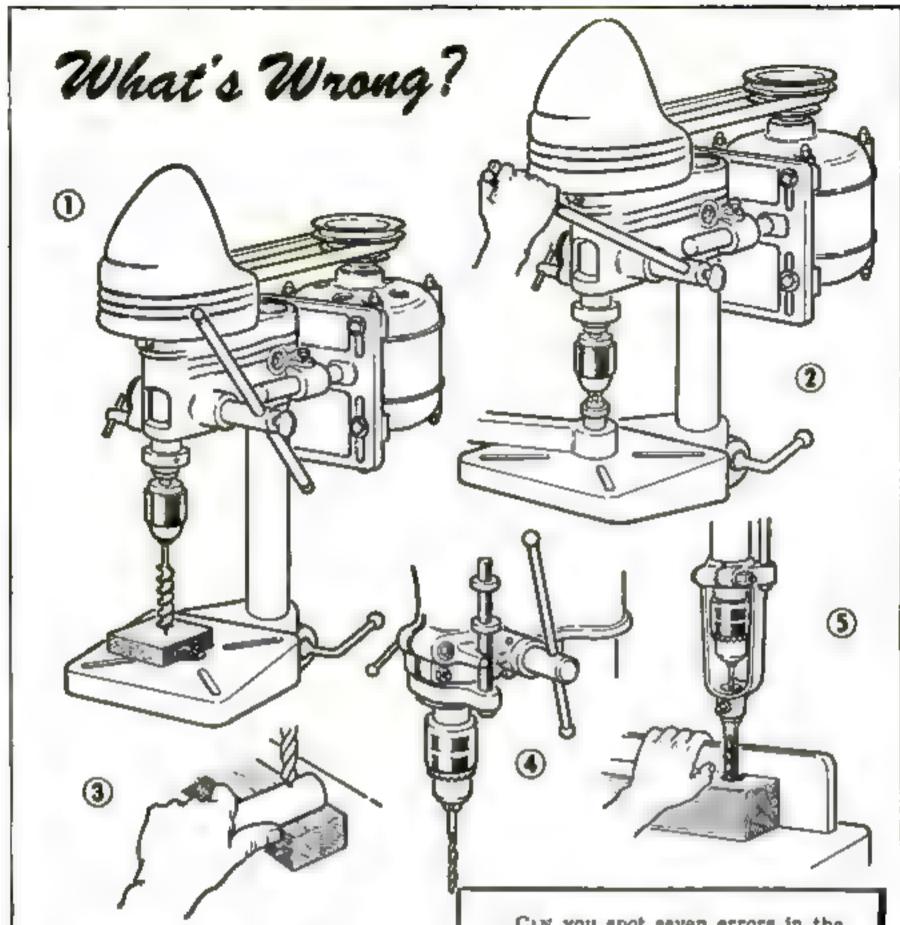
why Gasoline trucks trail a metal chain on the ground to drain off static charges can be demonstrated vividly. Put a few drops of carbon disulphide (CAUTION: inflammable) in a metal bottle cap and hold the charged electrophorus near. The tiny spark produced is enough to ignite the vapor. Static electricity caused by the movement of one object over another is often a hazard that precautions must be taken against in industry.

AN ELECTROSTATIC PENDULUM can be made by pasting a narrow strip of tin foil around a table-tennis ball and suspending the ball on a dry thread attached with adhesive tape. To make it swing, hold the charged electrophorus at one side and a knuckle at the other. The ball is attracted to the electrophorus, takes a positive change, is repelled, touches the knuckle, loses the charge, and so on until the electrophorus charge runs out. Foil merely carries the charge around the ball.

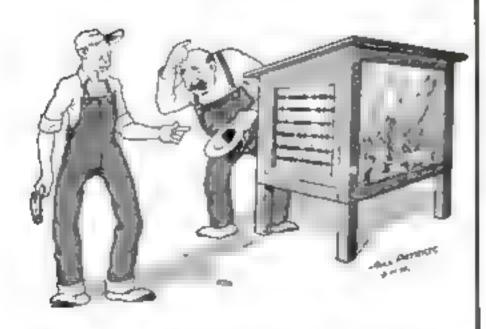




NOVEMBER, 1945



MORTISE AND TENON



"But you told me they liked to multiply."

CAN you spot seven errors in the above drawings, in which (1) the drill press is set to bore a hole in wood, but three things are wrong; (2) it is used to press in a small bearing; (3) a hole is to be drilled in a round metal bar; (4) the stop is set to limit drilling depth; and (5) a mortise is being cut?

Vibration may after the setting.

J. Hold-downs must be used. Otherwise the chisel cannot be withdrawn from the work,

2. Use as an arbor press is an abuse.
3. Round stock should be held in a
V-block to prevent rolling

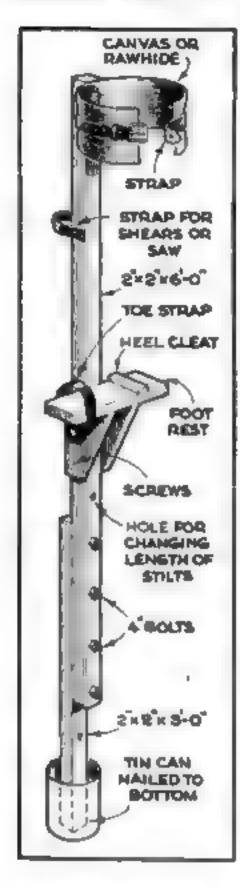
V-block to prevent rolling

Linless the lock nut is tightened,

A. The belt should be shifted to low speed, An auger bit should not be used unless the threads on the point are filed off. The table should be shifted to let the bit sas through the center hole.

VNSMERS





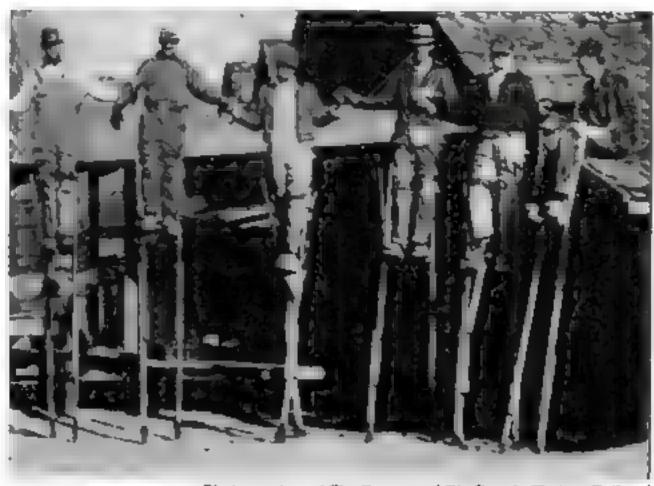


Photo couriesy of The Denver and Rio Grande Western Railroad

MOUNTED ON STILTS, orchardists in the Grand Valley of Colorado stalk from tree to tree pruning the topmost branches with the greatest of ease. The neighbors chuckled at such an apparently impractical notion when stilts were first introduced to the community. But now they're all doing it—and find that the work goes much faster than when they had to move ladders.

Each stilt is usually made of two pieces of 2" by 2" stock, one 3' long and another 6', overlapped and bolted together so that the stilt can be lengthened or shortened in a jiffy. The tops are fastened to the wearer's thighs with a broad canvas or rawhide band and a leather strap, leaving the arms free to work. When not in use, pruning shears and a saw are carried in leather loops placed near the top of each stilt. A block of wood the size of the shoe, with a toe strap and heel cleat, gives support to the entire foot. Tin cans slipped over the bottom end and nailed securely keep the stilts from sinking in soggy ground.—ALICE S. COOK.

FENCE BUILDING with a tractor may sound like a lazy man's dream, but it is actually a practical and sound procedure. While erecting woven wire fence on his farm near Hebron, Ind., George S. Clark put his tractor to work with complete auccess as a wire stretcher. Attached to the fence with a chain hitch. the tractor was inched forward until the wire had been pulled to the desired tightness. Then the brakes were set while the fence was made fast to the posts. The stunt saved him time as well as effort.



Court Tennis: "King of Games" (Continued from page 185)

pected to make the ball fail closer than that to the rear wall, on its second bounce. If he does this, he wins a point; if he doesn't, he loses a point.

If the ball was only a yard or two from the rear wall when the chase was made, this is pretty difficult. But it's fairly easy if the ball was a considerable distance from the wall originally. Bounces off the walls or roof don't count. The marker goes wholly by bounces off the floor.

Even so, it's sometimes hard to say for certain just where a fast, low ball hits the floor the second time, so the marker needs sharp eyes. In days of old, the kings addicted to this sport often took their own markers with them when they saltied forth to play tennis.

There's a reference to chases in Shakespeare's Henry V. The king brags, when be receives some tennis balls sent to him by the Dauphin of France:

"When we have match'd our rackets to these balls

We will, in France, by God's grace, play a set,

Shall strike his father's crown into the hazard.

Tell him, he hath made a match with auch a wrangler

That all the courts of France will be disturb'd

With chases."

The king is boasting of his quick judgment as well as his skill, for chases make it possible for a player to profit by headwork as well as footwork. By permitting chases to be made, the player on the hazard end of the court may get over onto the serving side quickly and win points that would otherwise be lost.

Court tennis, in short, is a game of wits as well as a sport requiring strength, speed, and skill. Thanks to such provisions as the rule of chases, men who master this game can continue to play it successfully for more years than they can go on winning at lawn tennis.

It takes time to learn the game, and comparatively few players really master it. There are so many ways of imposing handicaps, however, that players need not be of equal ability to have fun.

One player, for example, may give another a bisque, which means that he concedes one stroke in each set. Or two players may agree to bur the openings, by depriving the better player of a point every time he lams the ball into any of the windows. An even tougher bandicap is to bur

odds loses a stroke whenever he returns a ball in such a way that it touches any of the walls. Many years ago, there was a champ who jumped in and out of a barrel between shots to handicap himself when playing against his inferiors.

Doubles as well as singles may be played, and an expert may take on two opponents simultaneously. The world's champion now is Pierre Etchebaster, the professional at New York's Racquet and Tennia Club. After winning the title in 1938, he played an exhibition set against the world's second-best and third-best players and beat them both at once.

Although court tennis was made possible by princes and courtiers who wore lace on their pants, it is no sport for sissies. It can be played rough and fast. In Joan of Arc's time, a woman astounded Paris by defeating nearly all comers at court tennis, but it has generally been a man's sport.

The most famous court of all is probably the one at Versailles, where the representatives of the people met during the French Revolution and took an oath to stick together until a constitution was established. The court was never used again for tennis games. But history ascribes the decline in the popularity of court tennis to the growth of the theater, rather than to the tabous of kings or the foes of kings. The courtyards in which the nobility played were used by roving companies of actors, and the use of these costly arenas as theaters gradually relegated to the past the game that preceded lawn tennis by many centuries.

Earth-Shaking Storms Are Really That

THE earth actually trembles from the effect of great storms at sea. This almost imperceptible shudder of land masses, known as a microseism, has been studied scientifically and the findings presented by Leonard M. Murphy, of the U.S. Coast and Geodetic Survey. Records of these tremors have been made at 13 stations in the United States, Alaska, and Greenland for three successive seasons between October and March. The findings indicated that the trembling recorded by the instruments increased in proportion to the size and intensity of the storm, even far inland. But storms off Newfoundland recorded in the United States failed to register in Greenland; nor did storms off Greenland register in the U.S.

Leuna could be identified from the air by the pools of water in the near-by strip-mine pits and the row of 18 high chimneys rising from the boiler houses in the center of the long plant. But she had hundreds of special ovens which enabled her to conceal herself with a screen of smoke. This screen, moreover, could be shifted from day to day so that the plant lay under different parts of it at different times.

The Germans also had invested several years' work and millions of dollars in airraid defenses before the Eighth Air Force and the RAF went to work on Leuna. Within the plant there were not only shelters for the workers, but also heavy, reinforced-concrete and brick shields over and around much of the vital apparatus. Nearly two thirds of the plant's employees, moreover, were members of an elaborate and well-trained air-raid defense organization.

Outside the plant there were decoy structures which looked so much like Leuna. from the air that more bombs were sometimes dropped on them than on the real plant. And Leuna was surrounded, in addition, with so many antiaircraft guns that airmen considered attacking her one of the

most dangerous of all missions.

The RAF had dropped a few small bombs on Leuna early in the war, but the big battle did not begin until the spring of 1944. The strategic bombers set out then to stop Leunz and her sister plants from producing any more fuel for Hitler's military forces. This was done so successfully that from D Day to V-E Day the Germans were hampered by a shortage of fuel. But Leuna continued to resist the airmen until the last few weeks of the war.

Pirst Knockout. The Eighth Air Force's B-17's streaked across Germany, surprised Leuna's defenders, and made the first American attack on her in May 1944. They bombed her in daylight from an altitude of about 25,000 feet, and hit her with 1,500 of the 6,500 bombs that they released that day. Her innards were ripped and punctured by nearly 100 tons of high-explosive bombs. The shelters built for the workers were so grossly inadequate that 126 persons were killed and three times that many were wounded. Leuna's production stopped abruptly.

Second Knockout. But the big plant's compressors were soon turning again, so the Eighth Air Force sent out B-24's and socked the plant a second time two weeks later. Fewer bombs were dropped in that raid, but a greater percentage of them hit the works, and Leunz stopped breathing again. The morning before this attack, nearly 5,000 men had been busy repairing damage done by the previous raid; the next day, only about half of them reported for Work,

Third Knockout. Nevertheless, by the first week in July, Leuna was producing about three fourths as much as before the battle began. So the Eighth Air Force bombed her for a third time, using still fewer bombs but accoring hits with almost half of them. Even so, luck favored Leuna and she was knocked out for only three days.

Fourth Knockout. She was more than halfway back to normal on July 20, when the Americans bombed her for the fourth time—and left her breathless for five days. Such quick comebacks were possible because the Germans put enough men to work to patch Leuna up almost as fast as the bombers were tearing her apart. But the day was coming when the airmen would inflict damage faster than it could be repaired.

Fifth Knockout. By July 28, the big old cat was producing about a third of her normal output. The Eighth Air Force then attacked her twice, using 654 planes one day and 554 planes the next day. In those two raids, more bombs were thrown at Leuna than had been released in the previous four raids, and I. G. Farben estimated the damage done by these two attacks at 66,-320,000 Reichsmarks. (Common labor was paid less than one mark an hour.) Leuna then was such a mess, in fact, that it took her managers two weeks to draw up plans to put her on her feet again. Those plans called for production at about half of the normal rate by the middle of November, but the plans had to be revised and the date set back a month, because the Americans came back and socked Leuna several more times in the next three months.

Bixth Knockout. Nevertheless, despite more raids and many false alarms, Leuna struggled back into the fray for the sixth time—only to be knocked out again on November 21. While she was down this time, she was severely wounded by two more bombings. Some of her most vital heavy equipment was hit. But the Nazis then counted on her versatility to prolong her usefulness to them. They needed more explosives as well as more fuel, and orders were issued to shift much of Leuna's facilities from fuel production to manufacture of acid for explosives.

Seventh Knockout. By December, Leuna.

was back on the job but not producing much yet. Both the RAF and the Eighth Air Force attacked her then, with several thousand bombs, including 30 dozen of the RAF's powerful 4,000-pounders. The result was a 24-day shutdown.

Eighth Knockout. By New Year's Day, Leuna had been raided 19 times. Her airraid shelters had been so improved that there was not a single casualty within the plant during the heavy attacks in December, but the plant's ability to recuperate had gone the way of the Old Gray Mare—it wasn't what it used to be. When the RAF attacked her for the twentieth time, her compressors were making only about a sixth of the normal number of revolutions per minute. Nevertheless, the RAF socked her with more than five times as many tons of bombs as the Luftwaffe had dropped in the heaviest of its raids on London. This mighty cargo of destruction, moreover, included nearly 500 of the 4,000-pound hombs, which wrecked tanks and structures that smaller bombs did not damage seriously. This wallop left Leuna breathless for more than five weeks.

Ninth Knockout. Despite all this punishment, the Germans concocted a plan in February to revive Leuna for the ninth time. Two days later, some of her wheels began to revolve again, and by April 4 she was turning out products at about a fifth of her normal rate. The RAF returned then with a couple of its new 12,000-pound bombs, a half dozen of its 8,000-pounders, 200 two-tonners, and 2,000 smaller bombs. Leuna passed out then for the ninth time—and was still inert a few weeks later when the American ground forces arrived.

By then, the Allied airmen had hurled more than 85,000 bombs at this one target. Leuna had been defended so grimly that 128 bombers had been lost in the 21 attacks on her. I. G. Farben's experts estimated, however, that restoring Leuna would cost 280,582,000 Reichsmarks. Even more significant, however, was the record of Leuna's operations. In the ten months that she had been under attack, she had produced less than a tenth as much as Hitler and his trapped henchmen had expected from her. Airpower had made Leuna of little use to them at the very time that they needed her most.

Leuna had been defended so well that only about a tenth of the bombs launched against her had hit her. Others, however, had hit the waterworks, the mines, homes, garages, and other parts of the industrial community serving this mighty war plant. About a sixth of the bombs that fell in the plant did not explode immediately. Some of these were delayed-action bombs. Others

were duds, but even the duds affected the plant's production because they delayed repair work. According to the Germans, it took 17 days to remove the 142 unexploded bombs that were discovered after one attack.

When the Americans arrived, the plant had been damaged not only by detonating bombs but also by many secondary explosions. These had resulted from the formation of explosive mixtures in the gas pipes when operations were resumed after the pipes had been broken and punctured by bombs.

Fewer aerial attacks might have sufficed to knock Leuna out if the big 4,000-pound bombs had been used sooner. A single atomic bomb from a single plane could have demolished her.

But the Achilles' heel of Leuna was found by the airmen even though the weapons they used now seem puny. The monster's weak spot was her utilities—the gas lines, water lines, electric cables, etc. It had been possible to patch them up a few times, but, as the attacks continued, the difficulties became so great that even all the devout Nazis, resourceful engineers, and slave workers for Hitler had been unable to put this Humpty-Dumpty structure together again in such a way that it would stay together.

Farm Soil Test Reveals Ancient Burial Places

ANCIENT burial grounds may be discovered through simplified soil tests of unusual accuracy developed by Dr. Roger H. Bray, professor of soil fertility at the University of Illinois. Primarily for aiding farmers to determine the quality and needs of their soil for increased production, these tests have proved so accurate that the presence of phosphorus from long-buried bones has even led to the detection of the sites of prehistoric communities.

For agricultural use, Dr. Bray has prepared tables showing the percentage of maximum crop yield to be expected from various types of soils. From these tables, if there is normal rainfall, the farmer can forecast the increase he may expect as a result of correcting soil deficiency. Soil tests have been so simplified that they can be made by clerical help in farm-bureau offices after two-day "short courses" at the University. It has been claimed that, where there is black soil and sufficient rainfall, farmers may increase their yield of corn to more than 100 bushels an acre through the use of the Bray procedure.

So You'll See Better

Nature designed your eyes for seeing by day-light. But the average person spends most of his waking hours under artificial light.

To develop better artificial light —for all living and working conditions—has been a continuous project of G-E engineers and research acientists. They have even developed a whole new Science of Seeing.

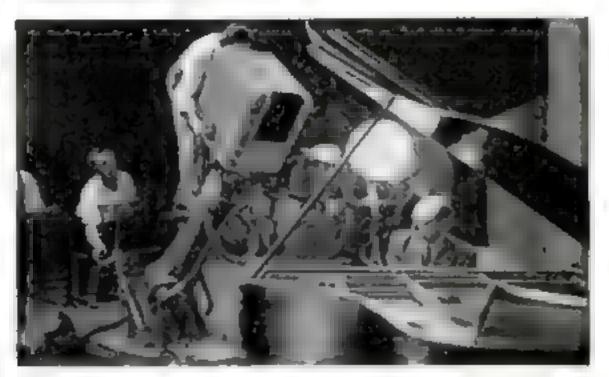
The pictures on this page illustrate a few ways in which G. E. is helping you see the day-by-day and night-to-night things more easily. General Electric Company, Schenectady, N. Y.



Powdered light. This luminous powder that you see is a phosphor. Coating the inside of every G-E fluorescent lamp, it transforms invalide a year to soft, cool light. Recently General Electric developed a remarkable new phosphor which will be used in a new fluorescent son lamp to provide healthful summer sunshine all year round, economically and efficiently. And speaking of economy, G-E lamp research has reduced the cost of a 60-watt G-E bulb by 75% since 1923. Another way in which General Electric helps to bring More Goods to More People at Less Cost.



The tiny 7-watt G-E bulb in this night light makes darkened halls safely navigable for sleepy people. It's especially useful in homes with small children. And the cost of electric current has been brought so low that, at average residential rates, this little lamp will burn for four 8-hour nights for only a penny or so!



You'll coon see events as they happen—by improved television with a bigger across and clearer reception. Back in 1928 a G-E engineer. Dr. E. F. W. Alexanderson, gave the first public television demonstration. And for more than five years now, G. E. has been telecasting regularly from its own station, WRGB, in Schenectady.

The best investment in the world is in your country's future

KEEP ALL THE BONDS YOU BUY





LOOKING for the speediest, smoothest cutting curved-tooth files in the world? Examine, "feel," try today's Nicholson Superior brand. Improved milling machinery—made only by Nicholson—forms the teeth with an accuracy, uniformity and "rasor-edge" sharpness never before achieved in files of this type.

Special attention has been given to proper rake and clearance. Correct curve provides a double-shearing action that makes it easy to prevent file running off line. Nicholson bardening methods keep the teeth cutting longer.

Use Nicholson Curved Tooth Files on cast iron, sheet steel, commercial annealed tool steel; on aluminum, magnesium, habbitt, brass, lead, soft alloys; on plastics, hard rubber, wood. Standard, Fine and Smooth cuts—for fast metal removal down to fine-finishing; for lathe, die and tool work. Rigid and flexible types.

FREE SOOK, "FILE FILOSOPHY"— 48 illustrated pages on kinds, use and care of files. For master mechanics, production and purchasing beads.

NICHOLSON FILE CO., 18 Acres St., PROVIDENCE 1, R. L.
(In Canada, Peri Hope, Ont.)

FILES FOR EVERY DISA

Television for You

(Continued from page 72)

dialer at the moment, but 129 applications to install transmitters are before the Federal Communications Commission, boss of all radio operation in this country.

Ultimately 450 to 500 stations, as compared with 900 aural stations that broadcast to listeners regularly, can be accommodated on the 13 radio channels set aside for television.

All this is on the credit side of television, but to say that everything is wonderful would be abusing the truth. It isn't.

The television people are acutely conscious of the fact that the eye is the most critical of the five sensory organs. The ear will forgive some background noises. The eye gets annoyed at anything less than perfection, and the television image isn't yet perfect. It has no "flicker" but often its "definition"—sharpness of detail—leaves much to be desired.

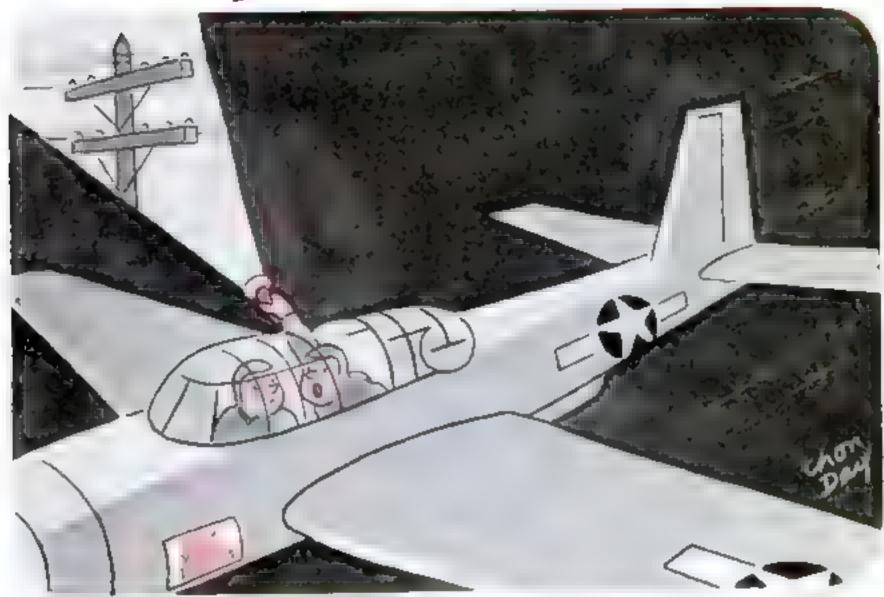
Television receivers won't operate in certain areas at all. They receipt for "ghosta," or one image overlaid with a slightly offset shadowy image, like a color picture in a magazine that is "out of register." This is due to "bounce" or reflected signals from the transmitting station, exactly like a sound that is echoed from a wall. Yet, in the strange world of electronics, often a receiver will pick up a good single image in reflection when direct pick-up is impossible. Ordinary foliage interposed between transmitter and receiver often proves to be a nuisance to the television set owner.

Electrical interference from machines that produce an arc, such as the diathermy equipment used by doctors and even the unshielded ignition systems of ancient automobiles, is so serious that the television image is destroyed entirely. The problem of antennas, particularly in big cities, is far from being solved. In the first place, an antenna must be in a direct line-of-sight with the broadcasting transmitter unless, perchance, a perfect reflected image is obtainable. In one area of New York City receivers can't pick up a certain transmitter, but they do very well with the signals inadvertently bounced off some cliffs on the west side of the Hudson River.

Apartment-bouse owners object to the installation of a forest of antennas on their roofs. That means that a common antenna for all the television receivers in a building must be erected. Moreover, one television receiving set may have a tendency to "feed

(Continued on page 214)

fresh Eveready Batteries



"Are you sure we aren't a little lower than you thought?"

No more NEED to accept substitutes for fresh, duted "Eveready" flashlight batteries! Your dealer has ample supplies of these famous, long-life batteries right now—in the size you need.

That's because—for the first time since Pearl Harbor—production is now adequate to take care of both military and civilian needs

So ask your dealer for fresh, dated "Eveready" flashlight batteries ... with the famous date-line that means full power, fresh energy, long and dependable service.



The word "Everendy" is a regulered trade wark of National Carbon Company, inc.

TO SPEED THE PACE OF PROGRESS

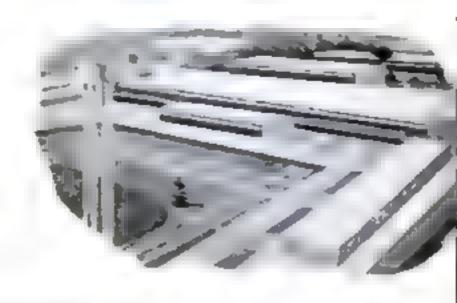
— and bring you better things more quickly



LOCATED ON a major highway leading trees. Detroit, access to the Center with the through the Administration building sketched here. A system of modern roadways will provide practical opportunity to study traffic control as well as to make simple road tests of new car developments.

A FLOOD OF SUNSHINE will pour ento the southern windows of the Research Bushings where experiments work is carried on in such diverse fields as the study of chlorophyl, research into fuels and engine design





KEEP AMERICA STRONG-BUY MORE VICTORY BONDS

The New GENERAL MOTORS TECHNICAL CENTER

will be created to stimulate opportunities, promote employment and bring about MORE and BETTER THINGS for MORE PEOPLE

THESE are times when the world cries out for new and finer things. There is a great hunger, broad as all mankind, for happier relationships among men—for greater individual opportunity for accomplishment, for more and better goods within reach of everyone.

It is by satisfying this hunger that we can bring greatest benefit to our national economy in the future. Through such action lies the road to more good jobs, to an ever-rising standard of living through the continual replacement of old things with new and better ones.

The General Motors Technical Center is dedicated to such an objective. It will occupy a 350-acre tract of land outside of Detroit as soon as conditions permit. Its purpose is to develop new things that add to the comfort and security of our living, and to enable existing things to be made more efficiently, hence at lower selling prices, so more people may own and enjoy them—all with expanding job opportunities.

It will shorten the time required to bring the work of creative thinkers out of the idea stage and into usable reality.

Here in groups of buildings designed especially for the purpose, General Motors will gather in advantageous and inspiring new surroundings the most modern facilities for research, advanced engineering, styling and the development of new manufacturing techniques.

Here physicists and engineers will discover new facts and convert them into new improved products. Stylists will give them new and more attractive form. Process engineers will develop better manufacturing techniques for making them.

Science here will go to work in the interest of economic progress. And history is full of proof that when science is so harnessed, more jobs are created, more comforts and conveniences are brought within reach of more people.

Serving as a source on which the engineering staffs of all of our Divisions may draw, the General Motors Technical Center will stimulate improvement in all General Motors products. Automobiles, refrigerators, Diesel engines, locomotives and other good and useful things may be expected to be improved at even faster pace than in the past.

But the work of the Technical Center will not be confined to existing things. It is dedicated to the idea that progress is the servant of mankind and that whosoever advances it not only helps himself but his fellow men. Its goal will be "more and better things for more people," whether that comes through improvement of the old or development of the new,

GENERAL MOTORS

MORE AND BETTER THINGS FOR MORE PEOPLE

CHEVROLET - PONTLAC - OLDSMOBILE - BUICK - CADILLAC - BODY BY FISHER - FRIGIPAIRE - GMC TRUCK AND COACH - SM DIESEL

Every Sunday Afternoon-GENERAL MOTORS SYMPHONY OF THE AIR-N&C Network



Interesting Cycling, you bet—and Incomparable Companionship with a pipeful of Irish Castle. How the ladies love its aroma-appeal. This custom-blend was tailored to taste by the master hand of Willoughby Taylor himself. That's why it took 8 rare tobaccos to create 1 C ... Turkish for mellowness,... tangy Virginias for fragrance,... Latakia for zest, and Perique for spice... sound White Burley for body and satisfaction. It's love at first sight with every puff... You'll see, when you smoke I.C.!



GET ACQUAINTED SPECIAL

for a limited time (and only if your dealer is out of statk) we I send you a half-pound humider of Irish Cost a Pipe Mixture for only \$1.10 Mail caupon with cash or check to Penn Tabacco Co., Dept. PNJ Wilkes Barre, Pa.

Name	
Address	

Television for You

(Continued from page 210)

back" into the antenna, affecting the reception of other sets using it.

The economics of the growing television industry are giving the treasurers of the broadcasting companies no end of headaches. It costs about \$25,000 to produce a half-hour show such as that put on by Jack Benny on Sunday. It will cost at least double that for a television program. That's because—if a play is presented—stage sets have to be built, even as Hollywood builds them, and actors and actresses have to memorize their lines. In presenting a show for the ordinary aural receiver a maximum of four hours of rehearsing is done-there is no scenery, the players are not costumed, and they may read their lines from the script and wear horn-rimmed glasses on their noses when doing so. For every hour of a television show 18 to 35 hours of rehearsing are necessary.

The high cost of production—to be borne, of course, by the advertiser—isn't as bad as it appears at first glance. Network shows ultimately may be "canned" on movie film, which projects nicely through a television transmitter, and be sold to scores of independent television broadcasting stations.

The economics of transmission will add to the cost of programs. There are three ways of long-distancing television signals: by buried coaxial cable, by retransmission from relay stations spaced a few miles apart, and—a brand-new suggestion—by equipment lodged in airplanes flying in the substratosphere. (See "'Stratovision' and FM Radio from Planes 30,000 Feet Up?" pages 92-93.)

Television signals, of course, have some of the properties of light beams. They are quasi-optical. They travel in straight lines. Those emitted by the National Broadcasting Company transmitter atop New York's Empire State Building, highest in the world, can be picked up no more than 45 to 55 miles away, due to the curvature of the earth. What engineers know as "refraction" adds about 10 miles to the "carry" of the signal.

Engineers of the telephone companies say coaxial cable transmits television signals most faithfully, without distortion. But 339 miles of it, between Meridian and Jackson, Miss., and Shreveport, La., cost \$7,056,000 to lay, and a rough estimate for the country as a whole is that television coaxials reaching 95 per cent of the population will cost upward of \$100,000,000.

(Continued on page 218)



or Double-Your-Money-Back

Does your car sputter and cough, refuse to start on cold mornings? Get touch-and-go starting all winter long. Get Casite...a pint in the crankcase every oil change...at service stations, car dealers and garages, everywhere.

THE CASITE CORPORATION + HASTINGS, MICHIGAN

WE QUARANTEE that any motor capable of being started in a warm room will start promptly in the coldest weather when Casite is added to the crankcase according to instructions. If your car fails to start quickly, you get double-your-money-back by filling out guarantee certificate and mailing it to The Casite Corporation, Hastings, Michigan. Maximum refund is \$1.30 per pint, twice the nationally advertised price of Casite.

GIVES BETTER AND SMOOTHER PERFORMANCE ALL-YEAR-ROUND



Now_it's the STINSON VOYAGER 150

There's no standing still at Stinson!

Your new Stinson Voyager will take to the air with a 150-h.p., instead of a 125-h.p. motor, as originally promised. Yet, there's no increase in list price for this 20 per cent increase in power.

And more good news! The new Stinson Voyager 150 will soon be rolling off the production lines.

Here's a roomy, four-place ship that has everything you've always looked for. The Voyager 150 has power to spare. And its high-altitude performance (1350-ft. take-off at 8700-ft. altitude . . . service ceiling 14,000 ft.) makes it a versatile plane anywhere. With its 500-mile range, its extra comfort, and low operating costs, this Stinson is a stand-out among cross-country planes.

The Voyager 150 will take you there and back in a hurry. It has a top speed of 133 m.p.h. and a cruising speed of 125 m.p.h. And even on long, cross-country trips, you'll fly comfortably.

The scientifically shaped, richly upholstered seats really let you relax . . . in the soundproofed, ventilated cabin of the Voyager 150. A cabin heater keeps you warm, no matter how cold it is outside.

In addition to the traditional Stinson stability, and proven wing-slot feature, the new Voyager 150 has a new tail design and other features to make it even more spin-resistant. And its flaps make even the shortest runways seem comfortably long.

The seven-foot landing-gear tread, steerable tail wheel, and push-button parking brakes give this Stinson extraordinary ground safety.

You'll have the assurance, too, that this plane is backed by Stinson's 20 years of experience in building quality planes, and by the vast research and manufacturing facilities of Consolidated Vultee Aircraft Corporation.

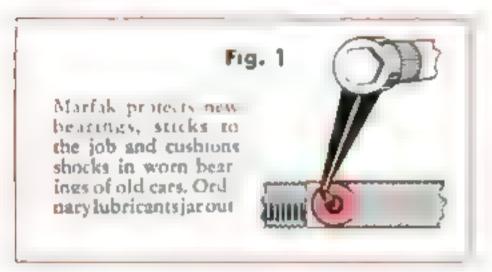
Let us send you a free illustrated brochure telling all about the Voyager 150. Write Stinson Division, Consolidated Vultee Aircraft Corporation, Wayne, Michigan.



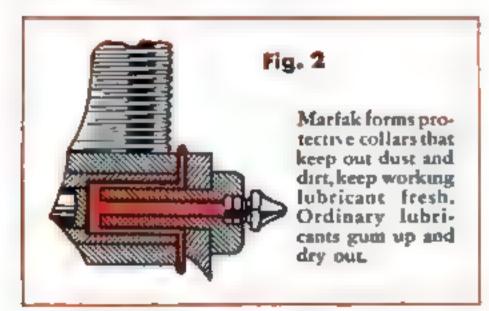
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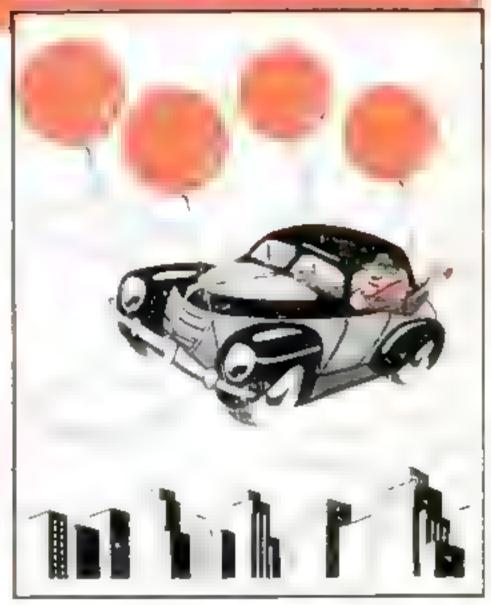
Why old cars "feel" better with MARFAK LUBRICANT

Marfak chassis lubricant is scientifically prepared to overcome the wear of bearing surfaces in old cars. Wear increases clearances, causing play and chattering in spring shackles, steering knuckle, king pins, etc. (Figure 1). These constant shocks further accelerate the wear of bearing surfaces and can cause front-wheel shimmy and excessive tire wear.



The combination of its ingredients gives Marfak "body" that keeps the clearances between vital bearings filled with a lubricant that has both cohesive and adhesive qualities. You can feel its cushioning effect as you drive.





Not only does Marfak cling to bearing surfaces and resist any tendency to wash-out, jar-out or squeeze-out, but it forms a protective collar that keeps out dust and dirt. (Figure 2).

Marfak also resists oxidation, and retains its superior lubricating qualities far beyond the life of ordinary lubricants. Because it stays on the job, it reduces wear and saves money by eliminating costly repairs and preserving tires.

Change to Marfak now. You'll find it economical in the long run, for it will help keep your car on the road!

THE TEXAS COMPANY



Don't miss the TEXACO STAR THEATRE on Sunday nights with JAMES MELTON and famous guest stars. See your newspaper for time and station.

You're welcome at TEXACO DEALERS





Men swear by electric razors—and the fine shaves they give. But they swear at the noisy radio static often created by the razor's operation! There's a simple way to correct this radio interference; just attach to the shaver cord a genuine TOBE FILTERETTE! Then when you shave, your family will hear radio programs clearly against a velvet background of silence! How much does it cost? Just \$1.98 post-paid for a genuine TOBE FILTERETTE—a famous trade name for 20 years. No installation trouble—just plug it in. Works on A.C. and D.C. Rush coupon.

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Television for You

(Continued from page 214)

Radio relay would be less costly, but that would require, among other things, "apex" stations. This means, literally, stations built on the peaks of mountains to lift the signals over the upthrustings of the terrain. RCA is concluding five years of experiments with unattended radio relay stations between New York and Philadelphia. The transmission by plane might be less costly.

It would be nice to say that all the television engineers are of one mind on what ought to come out of a receiver. They aren't. They hold views more divergent than the automotive engineers who produce in-lines and V-8's. What that really reduces to is an argument between most of the manufacturing and broadcasting industry on one side and the Columbia Broadcasting System on the other. Right now, through the efforts of a trade group, the "Television Broadcasters Association," the scanning lines that you will see on your screen are standardized. But some technicians, both in this country and abroad, insist that almost twice the "definition" can be obtained from finergrained images. The French have succeeded, in fact, in producing better images.

CBS, which only broadcasts, and NBC, which is a subsidiary of RCA, a manufacturer, are at swords' points over the question of transmitting color. NBC says it will be years before color television will be

practical.

The argument between NBC and CBS is more than academic. CBS next month will begin the experimental broadcast of television in color, using a transmitter on top of New York's Chrysler Building, second in height only to the Empire State. The man sparking the CBS campaign for what the company terms better television in color is Dr. Peter C. Goldmark. He exudes optimism.

"In the near future," he says, "we will have television pictures that are made up of approximately 1,000 lines, instead of the prewar 525 lines. The pictures will contain about twice as much detail of light and shade. The eye won't be able to detect the lines. It will make possible pictures at least 18 inches in height."

To get such pictures, he explains, television has had to "move upstairs" in the radio spectrum, into the ultra-high frequencies. It has had to increase its band-width of transmission from six to 16 megacycles.

All that backstage scuffling that is going on doesn't mean that television's arguments can't be settled. They are only evidence of growing pains.—DEVON FRANCIS.















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serve these leading airlines









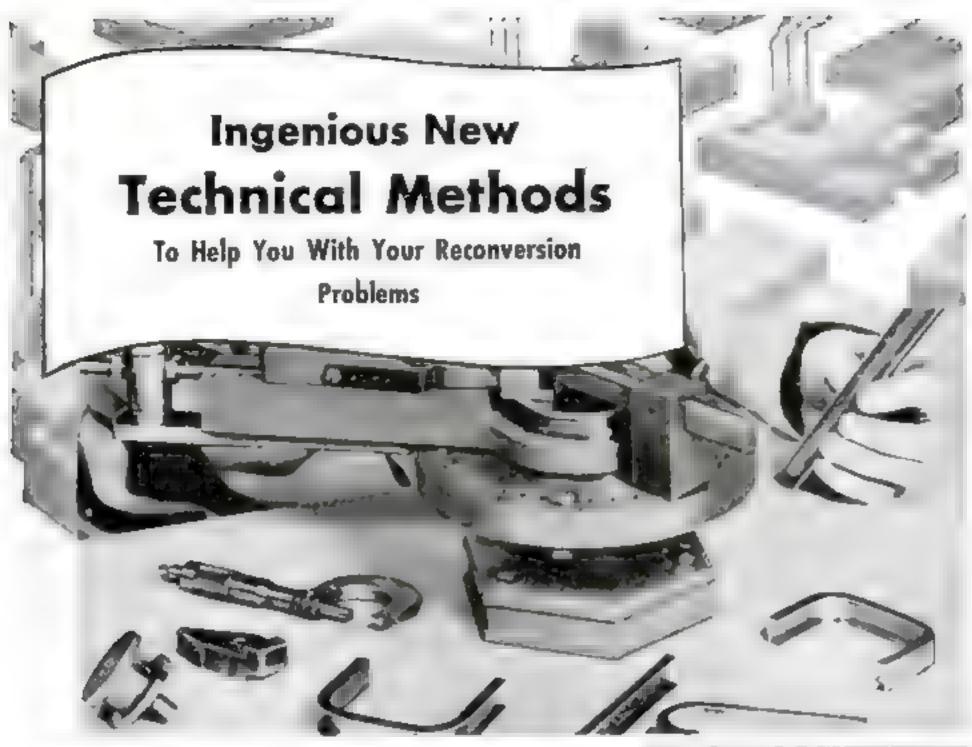




The American people always give an overwhelming vote of confidence to that which they know they can depend upon. Champion Spark Plugs have won this vote of confidence and are preferred by users on land, sea and in the air.

CHAMPION SPARK PLUG COMPANY . TOLEDO 1, OHIO

NOVEMBER, 1945 219



"DIE-LESS DUPLICATING" ELIMINATES TIME LOSS AND DIE EXPENSE!

The Di-ACRO Bender is a precision unit, designed to form and duplicate an unlimited variety of parts and pieces—climinating, in many cases, the need for special dies. Tubing can be accurately formed with the DI-ACRO Bender to a center line radius as small as 2½ times the outside diameter of the tube without distortion. Shapes and outlines, impossible to obtain with regular production dies, are easily formed with the DI-ACRO Bender. These include round, half-round, bexagon, and square rod, tubing, angle, channel, moulding, strip, stock and bus bar.

Stops may be set and material guides mounted or production work in excess of 1000 operations per hour. The Bender is compact and portable, ideal for temporary or permanent work. There are no extra parts to purchase, as the DI-ACRO Bender has been built to cover a wide working range, with simple conversions.

Peacetime production for industry, forecasts the return of Wrigley's Spearmint Gum—that favorite "help on the job," for workers everywhere. But Wrigley's Spearmint will be back only when conditions permit its manufacture in quality and quantity to meet your needs. Until that day, we ask you to remember the famous Wrigley's Spearmint Wrapper shown at right, as your guarantee of the finest chewing gum that can be made.

You can get complete information from O'Neil-Iewin Manufacturing Co., Minneapolis 15, Minn.

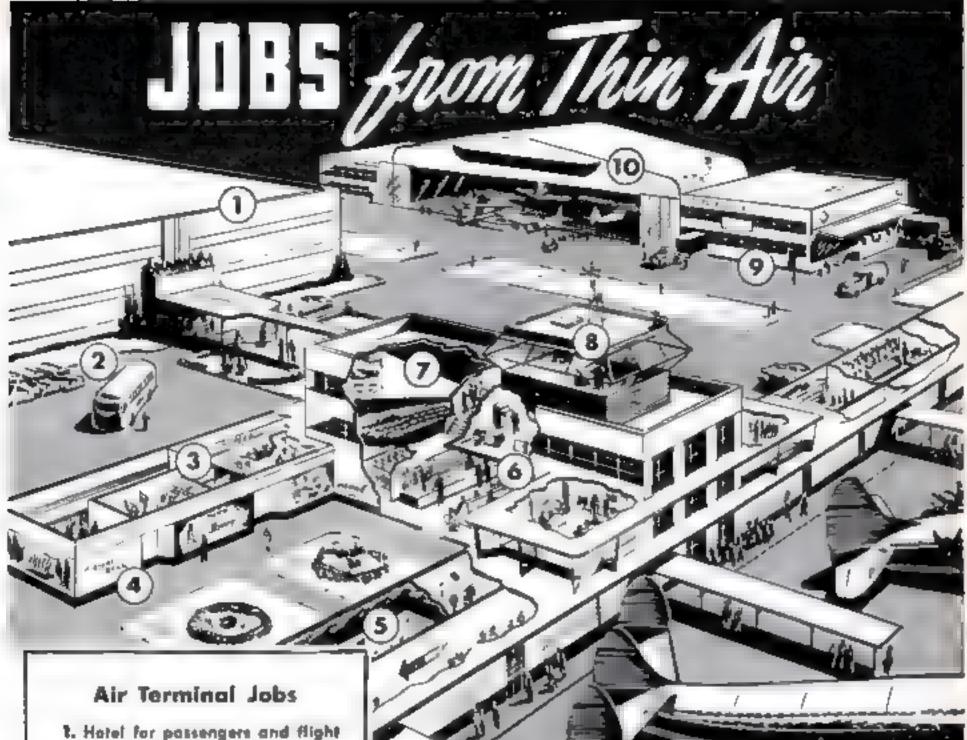


Typical Shapes Formed by the DI-ACRO Bendet



Remember this wropper

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- Shops, including clothes, shoes, hats, luggage, flowers, jewelry, drugs, books and photographs.
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Air service made these jobs, and Wright Cyclone engines helped build this form of transportation. More Cyclone-powered planes, such as the Lockheed Constellation, are now going into service. That means new air terminals, new opportunities for thousands of jobs.



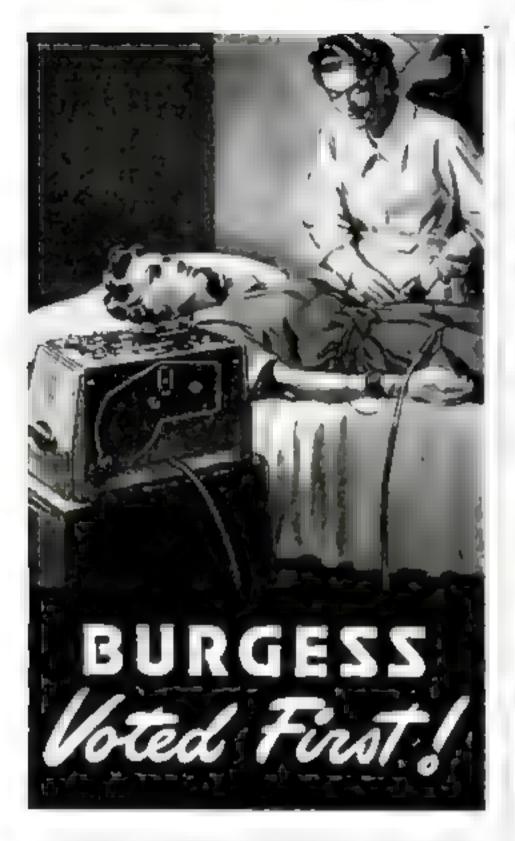
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HOW IS YOUR HOUSE HEATING 1Q?



How would YOU answer these important questions?









Do you think your fuel bill is too high?

Have you roasted in the living room in order to maintain a livable temperature in the rest of the house?

Have you found your kitchen too hot for cooking or washing dishes?

Do your rooms have "up-and-down" temperatures caused by "on-and-off" heat supply?

Is your bathroom too cold for that morning shower or evening tub?

Are your rooms hot at the ceiling and cold at the floor?

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The answer to these questions and many other house heating problems are given in the booklet, "Heating and Air Conditioning the Postwar Home," recently published by Minneapolis-Honeywell, It tells all about MODU-FLOW the remarkable new Honeywell control system.

Moduflow operates on an entirely different principle from the ordinary "on-and-off" heating system. It furnishes heat continuously at just the right temperature to offset heat losses, which are continuous. No more drafts or chilly periods caused by intermittent heat supply - just blissful comfort from head to foot in every room.

Best news of all is that you can install Moduflow right now in your present automatic heating plant. Mail the coupon today for the booklet that tells all about Moduflow.

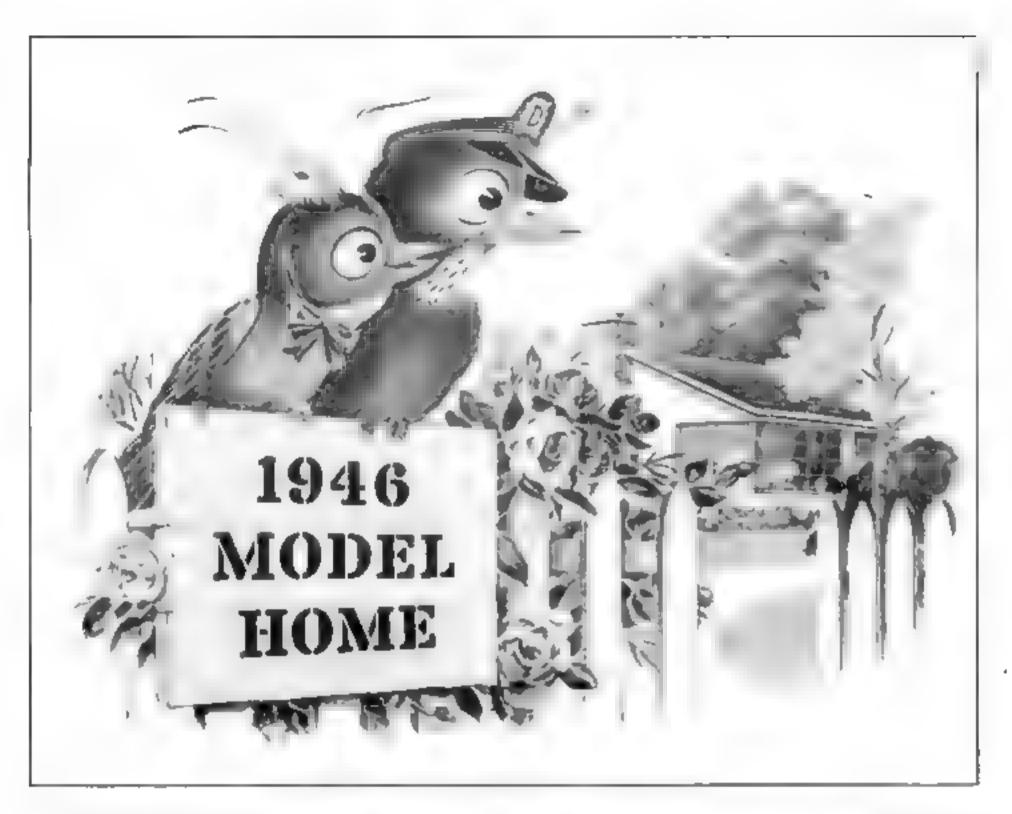
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With the final victory won, we now will be able to go ahead with the construction of the new Defoe Model Homes. Right now is the time to get your name on our mailing list so that you will receive one of the first Defoe catalogs.

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all of the economies made possible by volume production.

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This Christmas flatter the taste of a particular smaker—give him a box of

ALMENDARES Belvedere Perfectos

This clear Havana Special— Havana Wrapper and 100% Havana Filler is truly a cigar for conneisseurs in grome, flavor a

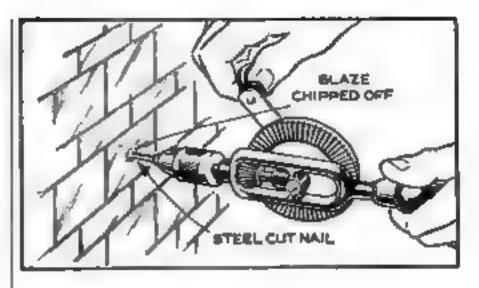
connaisseurs in aroma, flavor and appearance...
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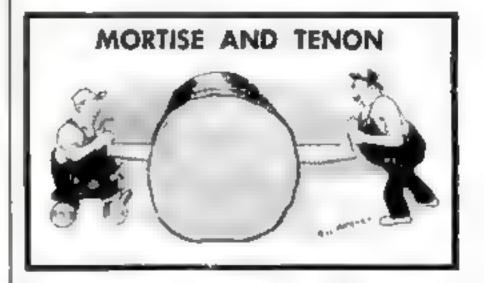
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Hole Quickly Drilled in Wall Tile with Steel Cut Nails and Brace

DRILLING holes in wall tiles often is a ticklish job, but I've found that it can be accomplished quickly with a steel cut nail in a hand brace. The first step is to chip off the glaze. Because of the hardness of the tile, it may be necessary to use several nails to complete the job.—AL FORTE.





- last longer give clean, uniform heat perfect flame control
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For warmth without drudgery. Modern Perfection Oil-Burning Heaters keep your whole house pleasant and hyable in cold weather. Dial control gives any degree of heat you want. Heat-directing shutters send heat where you want it. Blower and humidifier extend heat area and increase comfort. Economical, compact, Perfection gives you the time and comfort you need and want for Better Living!





For new cooking convenience! Modern Perfection Oil Ranges are unrivated for convenience, beauty and ease of operation! Each of Perfection's "High Power" burners gives any degree of instant, odorless heat you want. "Live

Heat" oven assures better baking. Sparkling, clean, and easy to keep clean, Perfection ends the drudgery of fire-making-gives you time and strength for Better Living!





For plenty of hot water! Modern Oil-Burning Perfection Hot Water Heaters assure a plentiful, convenient hot water supply at all times and every homemaker knows how important hot water is to the simplification of her tasks and the comfort of her family!



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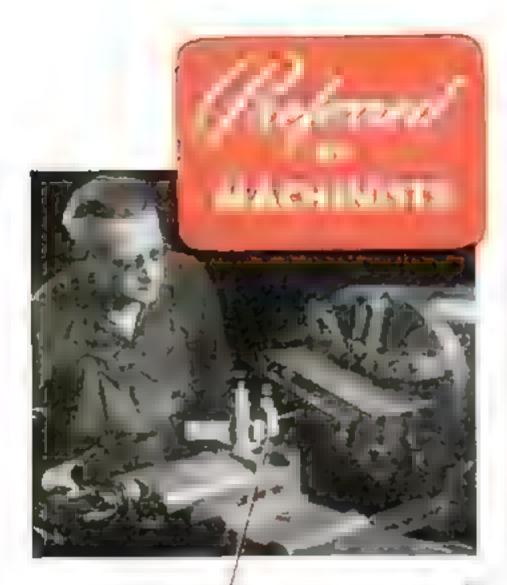
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Experienced machinists prefer Williams Tools because they help produce better work easier!

Backed by more than a half century of tool-making experience, you'll find these daily-used shop tools not only well-designed and accurately machined, but rugged and long-lasting because they are drop-forged by Williams.

Write Dept. S-11 for free Tool
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DROP FORGINGS AND DROP-FORGED TOOLS

Flying Tiger Van Line

(Continued from page 81)

freighter line on his old friend, Sam Mosher, president of the Signal Oil Company. Mosher consulted other friends, and the next day he made a counter offer.

"If you can get some money together," Mosher said, "we'll match it—dollar for dollar."

Prescott accepted the challenge. He cabled Dick Rossi, still flying the hump for CNAC. His phone hummed—to Duke Hedman in New York, to Jack Cornelius in Oklahoma City, to Bob King in Kansas City, and to others. Rossi kicked in with \$10,000. Hedman sent his contribution. The others came in, and Prescott added several thousand. When he finished counting, he had \$90,000. Mosher was as good as his word, and the money was matched.

Prescott dashed to the Surplus Property Board, which had acquired 14 of the Conestogas the Navy didn't want.

"We'll pay \$401,000 for all the planes, including spare parts," he declared.

"Accepted," the board told him, "pro-

vided you pay half down."

Prescott jumped at the chance. He worked fast to get the additional money for the payment. Before the ink had dried on the contract, he sold a pair of the planes to Azteca and four to Asiatic Petroleum. The remaining eight, all flyable save one, became Flying Tiger freighters.

But Prescott had not reckoned with one item in the contract—the spares. "You may call for these parts at Philadelphia," the board had told him. Prescott dropped into Philadelphia to pick up the spares. What he found was not a few boxes of struts and braces, but 2,000,000 pounds of wings, tail surfaces, everything needed to build and repair a Conestoga.

"We got 20 boxcar loads of the stuff," he recalls. "It would have been easy to build a complete airplane and still have 19 carloads left over." Unable to move the huge lot, he left it in storage.

It was July 3 this year that Prescott acquired the planes. Only a few days had passed before one of the Conestogas took off from the Detroit airport California-bound with enough furniture to fill five bungalows. At 700 feet and just away from the field, a muffler pipe fell off, setting an oil-scavenger line aftre. The pilot got the plane down safely, but the fire burned the craft and all its contents.

"One up and one down," grimly commented Jack Cornelius, operations chief. (Continued on page 234)





with a continuous

process of glass making



In 1923, a red bot ribbon of plate glass began to flow from a furnace in the Ford Rouge plant. Year after year, this ribbon poured out ... rolled into a long cooling oven ... moved onto the polishing line to be finished and cut into crystal-clear sheets.

This was the first continuous process of glass making... capable of producing more than three miles of plate glass every day.

Started in a limited way in 1920, this process was conceived by Henry Ford to make possible the use of finest quality plate glass in low priced cars. And it hastened another great Ford "first"... safety glass as standard equipment "all around."

Following his usual policy, Mr. Ford made the continuous process available to all Industry without royalties. Thus, throughout the world, people came to enjoy the beauty and utility of plate glass, not only in their automobiles but in their homes as well.

Ford will produce many more such "firsts" in the future—to the lasting benefit of every owner of Ford-built cars and trucks.

EXPECT THE "FIRSTS" FROM FORD!



The Amazing Outdoor "Pocket" Stove of Tomorrow!

All during the war, this famous Coleman Military Burner was used by our fighters on battlefronts all over the world—for cooking food, heating drinks, purifying water and even keeping warm.

Soon, it will be the Coleman "Pocket" Stove you'll want along on every outdoor trip—the grandest little sport stove you ever touched a match to! BURNS ANY KIND OF GASOLINE—White or Leaded! Ready in minutes for quick-cooking action.

Compact, amazingly efficient! Easy to carry as a quart size can of food. Only 8½ inches high; 4½ inches in diameter. Telescoping case makes two handy cooking utensils. It's the perfect pal for your hunting, fishing and camping trips—for vacations, picnics, backyard snacks. Thousands of uses around the home and in the workshop. Quality built for long, trouble-free service. Watch for the Coleman "Pocket" Stove. You'll want one!

New Pictorial Folder showing some of the many uses for this little "Wonder Stove" now in preparation. Copy will be mailed to those requesting as soon as it is available. Write for your copy.

THE COLEMAN COMPANY, INC., 264-PS, Wichita, Kansas





NEW BALLENTINE SINGLE VALUE CAPACITOR MOTOR

This miniature powerhouse heads the parade of Ballentine Motors now rolling off the production lines and available for prompt delivery.

Like all QUIET Ballentine Motors, the Single Value Capacitor Motor is the result of expert craftmanship at its best—precision dynamic balance—strict adherence to close tolerances It is especially suitable for built in applications, as it has no switches—no brushes ideal for projectors, fans, and similar applications where high heat losses are not desirable.

Other QUIET Ballentine Motors from 1/1000 to 1/8 H.P. will soon be available.

SPECIFICATIONS

Single value capacitor motor. Diameter 3½: Length 3½: Double or a no elatification of pole -1 20 h.p. 3400 RPM 4 pole -1 25 h.p. 1700 RPM Strap type mounting. Cool running 50% efficiency. Moto parts—rolor and stator available for built in applications.

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RUSSELL ELECTRIC COMPANY

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NOVEMBER, 1945

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of the waterproof watch that winds itself!



What keeps the Croton Aquamatic going? The natural motions of your wrist! You can wear it night and day — it won't "run down" or need winding.

13.5% MORE ACCURATE, TOO!

In a 30-day wearing test by a famous laboratory, three Croton Self-Winding Aquamatics proved to be 13.5% more accurate than the average of nine nationally-famous stem-wind watches.

A Croton has everything? Guaranteed waterproof—resists shocks—sweep second hand—unbreakable crystal—radium dial. Everything a man wants in a 17-jewel watch (plus self-winding) for only \$49.50? Pad. Textual.

P. S. Write for Souhing L. 30 Groten, St.W. State, M. Y. 19,



Flying Tiger Van Line

(Continued from page 230)

"We did better than that even in China."

He was right. The boys had certainly piled up a record and experience in China that stood them in good stead. On Christmas Day in 1941, 14 Flying Tigers tackled 70 Jap fighters and bombers over Rangoon. Hedman alone got five during his first crack at the Nips. Prescott proved his courage and flying ability by knocking down an even half dozen, "one here and one there." He poured 1,000 rounds of ammo into a fast photo ship, literally burning up his guns in a series of bursts, before the Jap went down.

Undaunted by the Detroit mishap, the boys started leaping around the nation, knocking on doors, asking for business. It wasn't long coming. On a recent Wednesday night, two Conestogas took off from the airport at Bakersfield, Calif.—one bound for New York bearing four tons of strawberries, grapes, and cantaloupes, and the other for Atlanta, Ga., with a similar load. All the produce sold at fancy prices three hours after the markets in those cities

opened on Friday morning.

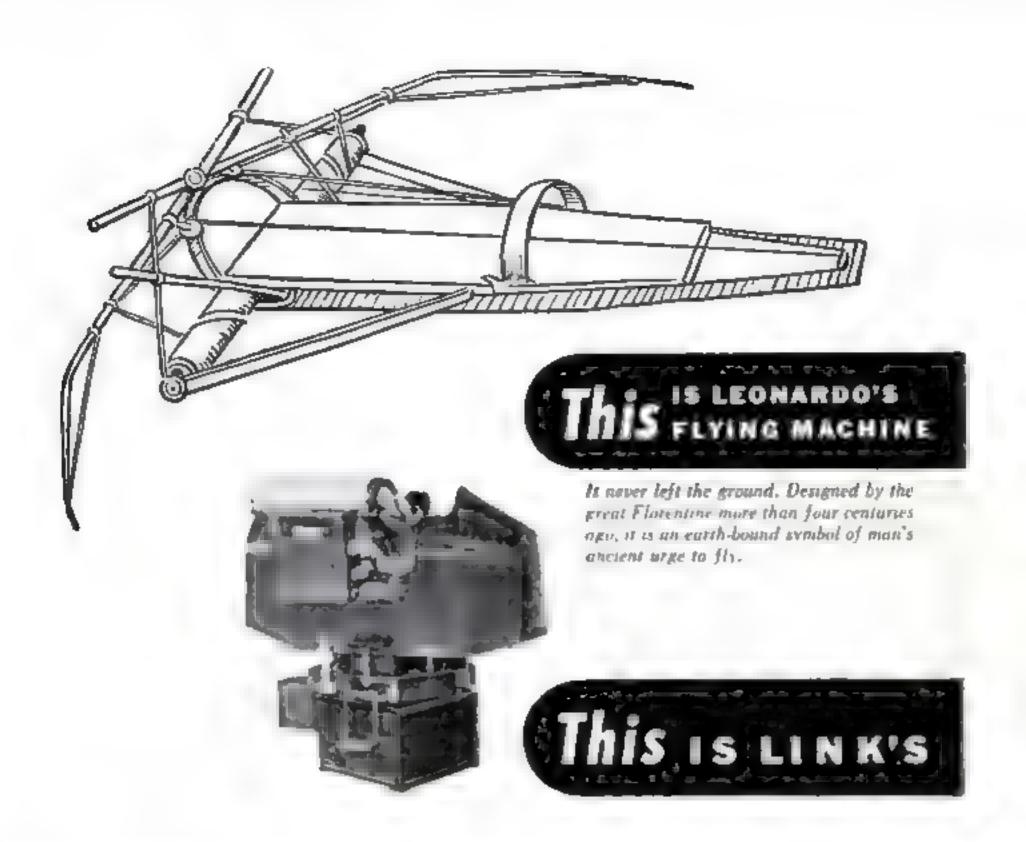
The former Tigers operate their venture on a co-operative basis, consulting on all problems with Prescott arbitrating close decisions. They offer a 24-hour service from coast to coast and will fly anywhere in the world. The voluminous belly of the Conestogas—the name means "prairie schooner"—can carry planos, automobiles, or horses, and the boys hope to build up a nice business moving race horses six at a crack from track to track. As for perishables, refrigeration offers no problem. When told to keep such produce at an even temperature of 50 degrees, the pilots simply watch their thermostats closely and fly at the proper altitudes,

Prescott thinks this is the most extensive business venture yet tried by veterans. Certainly, it's a novel undertaking. Hedman dropped into Ashfork, Ariz., not so long ago to pick up an automobile that had been stranded there for lack of parts and landed the car in Los Angeles. At another time 24 Marines, anxious to hit California in a hurry, chartered a Conestoga for a

special flight across the country.

All the 20 employees, former AVG flying and ground men, spring frequent ideas for the use of their airplanes. The backers and the vets own the outfit half and half. But the vets run it.

"We give them a little advice," says Mosher. But the Flying Tigers find the loads and haul them—anywhere, any time.



THE LINK was never made to fly. It is man's first successful attempt to simulate airplane flight on the ground. More than twenty years of experiment and improvement have made today's Link Trainer an engineering marvel.

of flight. You see and sense for yourself how a plane acts in the air, how it responds to power and controls. You learn the flying terms and what they mean to a pilot. You become familiar with the marvelous instruments which have contributed so much to flying safety.

THE LINK in the standard training device of the air forces and the airlanes. Soon Link instruction will be available to all. When and if you fly, you will have more and safer use of your private plane if you are Link trained. Your time in the Link will prove invaluable. For the first principle of flying skill and safety in darkness and in "weather" is to know and to obey your instruments. Link Aviation Devices, Inc., Binghamton, New York. Makers of Link Trainers, Crew Navigation Trainers, and other devices contributing to the safety of flight.

Link training is your first step into the FLYING AGE



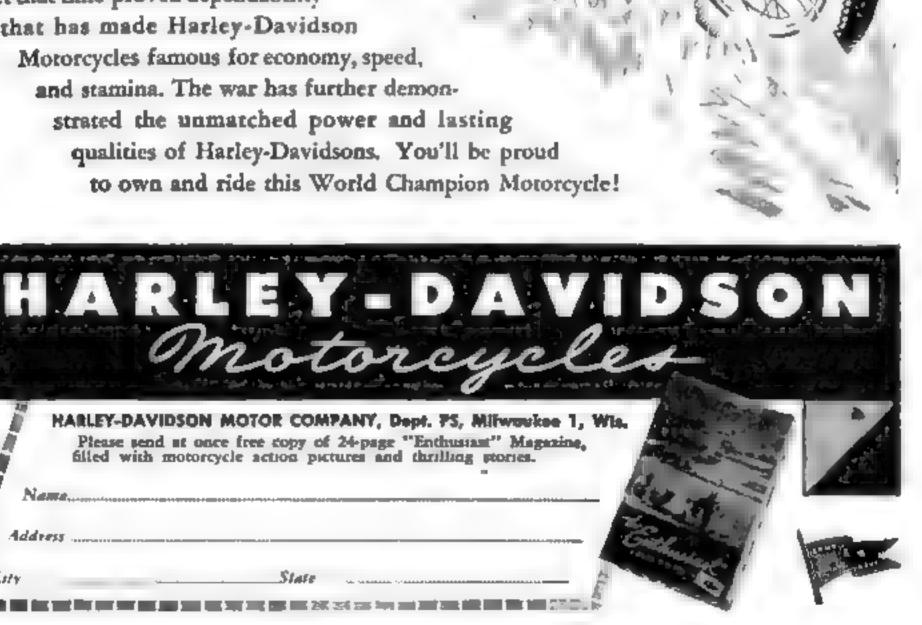
HARLEY-DAVIDSONS ON THOUSANDS OF

"Want-First"

LISTS

Eager for fun and thrills, many thousands of fellows are looking forward to the time when they can own Harley-Davidson Motorcycles, They know plenty about the dependable performance of Harley-Davidsons under toughest road and weather conditions - and in the deluge of letters they send in, they keep saying, "I've got a new Harley-Davidson on my went-first list,"

Thanks, fellows - and you'll get that time-proved dependability that has made Harley-Davidson Motorcycles famous for economy, speed, and stamina. The war has further demonstrated the unmatched power and lasting qualities of Harley-Davidsons, You'll be proud to own and ride this World Champion Motorcycle!



"When I need a knife, I reach for X-acto!"

Expert Hobbycrafter Says X-acto Indispensable For Fine or Heavy Work

"Couldn't do without those handy little cutters," says Kenneth Whatmore, New York advertising executive. "Boots are my main hobby, and I find a hundred uses for my easy-cutting, non-slip X-acto haife, both in heavy building and fitting, and in carving the trim by hand.

"But believe me, X-acto is just as ideal for delicate jobs, too. Recently I designed a model post-war store, and cut the whole thing out of cardboard, in ministure, with tiny showcases, furniture, and even a merchandise display. I don't know how I could have done such a tricky job without those keen-adged, sharp-pointed X-acto blades to get in and around the sharp curves and corners."



Christman Inspiration!

X-acto De Luze All-Metal Knife Chest, \$5. Three X-acto Knives, with an assortment of extra blades, in a handy wooden chest. Dream gult for hobbycrafters man, boy, or girl,

PROS. U.S. Pat. OR.



Always Sharp, Always Ready -Blades For Every Purpose Quickly Interchangeable

Take your choice of three firm-grip handie styles, designed to fit the hand perlectly, giving greater skill and control.

Then slide in the most suitable of the 10 assorted blade shapes. (This takes about five seconds.) Each designed for a special purpose. All of finest surgical



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Nonreflecting Glass

(Continued from page 96)

vacuum process to a mass-production basis. The number of coated elements made now runs into the millions and they have seen service all over the world, yet only a few civilian photographers have as yet had a chance to use them.

The Kodak Ektra was the first stock camera to come with a coated lens and was followed by the Kodak Medalist. Only a few of these had been manufactured when the war stopped production. The Eastman company has had its hands full the past few years producing cameras and coated lenses of many kinds for the services.

The more complicated the lens system the more its efficiency is improved by the coating process. The light loss—that is, the reflected light—is around five percent at each glass-air surface, or 10 percent for each element in conventional lenses. With multiple-element lenses the transmission loss may add up to as high as 50 percent or more. When all surfaces are treated this loss is cut to a negligible amount.

It is not, however, the greater transmission of light that primarily gives the improvements noted in photographs made with coated lenses. Rather it is the elimination of multiple reflections that bounce back and forth between the various surfaces, causing ghost images and haziness.

A photograph taken with a coated lens against the light carries clear-cut detail into the deepest shadows, whereas the uncoated lens veils the shadows with haze. In color photography the improvement is even more pronounced than in black and white. There is more faithful reproduction of colors, as well as clearer detail.

Since the vacuum process is hardly practical for large surfaces, such as plate-glass windows, other techniques for this purpose have been, and still are, under development by a number of concerns. RCA Victor Laboratories at Princeton, N. J., report success from a process of applying electronic control to the etching of glass by vapor of hydrofluoric acid. There is no apparent limit to the size of the glass surface that can be treated by this method. Glass etched to such a minute depth as one fourth of a light wave's length is not frosty looking, but is actually more transparent than ordinary glass.

RCA's research in this field was based on the need for nonreflecting glass to improve the images in television, and this is another application where it will mean a lot to all of us.



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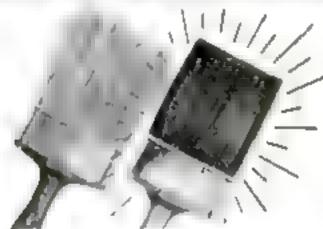






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Radar of the Deep

(Continued from page 87)

sound. In the schoolroom, a balloon full of gas is sometimes used to demonstrate this. A watch held against the balloon can be heard ticking far away. In sonar equipment, a chamber filled with carbon dioxide gas, or a vessel full of special oil having the right acoustic properties, may be used to intensify

the sounds picked up.

Use of sonar was limited for a time by troubles resulting from changes in the temperature and density of sea water. Warm and cold layers, such as you have encountered when swimming, refract sound waves. Submarines could hide in sonar "blind spota." But now, allowance for the deflections can be made when the temperature gradient is known. A device called a bathythermograph is used to obtain this information. It is a combination thermometer and depth indicator. One type of bathythermograph is used for close-to-the-surface recordings and another for deep readings, where much greater pressure is encountered.

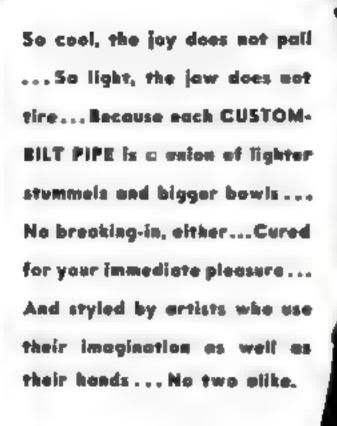
Although the employment of high-frequency sounds is a recent development, and much research remains to be done, the idea is old. Super-sounds may be produced by either magnetostriction or "piezoelectricity," and use has been made of both methods.

Magnetostriction transmitters are based on the discovery that certain magnetic materials are bent rapidly back and forth when magnetized by alternating-current electricity. A steel bar, for example, can be made to vibrate at such speed that it will produce almost pure tones; the sound waves emitted in some sonar devices are created in this way.

Pierre Curie (later to win fame as a discoverer of radium) discovered piezoelectricity in 1880, when he found that certain mineral crystals change in thickness and length when excited by electrical currents. Conversely, when pieces of crystal are vibrated by mechanical means, charges of static electricity are developed on their surfaces. These crystals have a certain grain. or electrical axis. When they are properly cut into disks or rods, they vibrate, or oscillate, uniformly. Hence, crystals can be used as "valves" to stabilize radio and radartuning frequencies. Quartz is used in most electronic applications, while Rochelle salt is employed in most sonar ranging equipment.

Sound waves set up by magnetostriction or piezoelectricity can be directed like rays from a searchlight and projected through the cold, dark waters of the sea for miles.

(Continued on page 250)

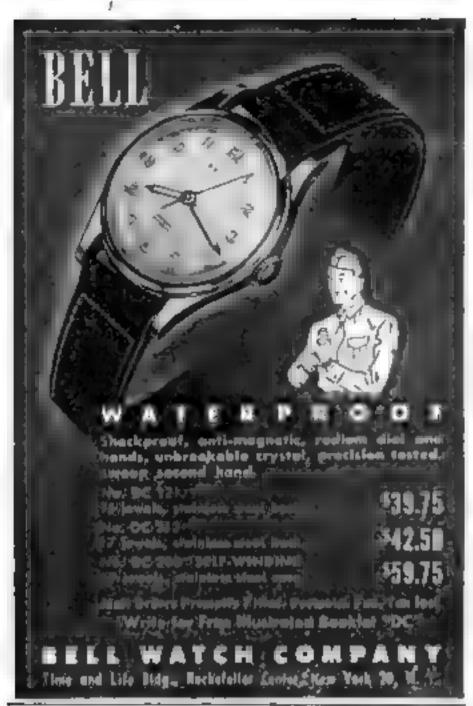




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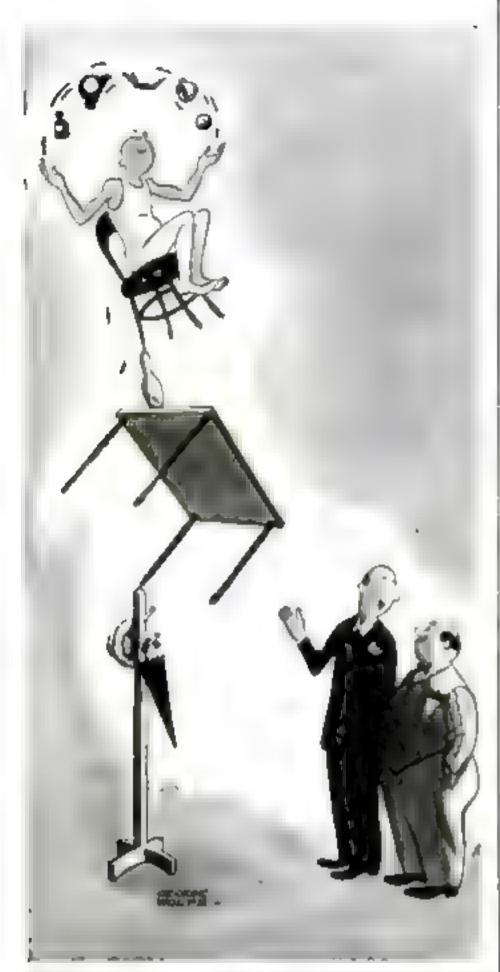
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Radar of the Deep

(Continued from page 246)

Some of the sonar ranging devices used by the Navy to detect targets will reveal the presence of certain objects at distances greater than six miles.

The use of supersonic rather than sonic vibrations makes it possible to control the direction and concentration of the waves emitted with much greater accuracy, and to eliminate side echoes and extraneous noises such as those from waves and other ships which might mislead the sonar operators. The new eyes and ears of ships, moreover, do their jobs as silently as those of people.

Navy rangers have cathode-ray BDI (bearing direction indicator) scopes which tell the operator the direction of the object detected. Another indicator called the MTB (maintenance of true bearing) may be attached to both the projector and the ship's gyro compass. When this "target holder" is engaged, it keeps the sonar ranging projector trained on the target regardless of

the ship's maneuvers.

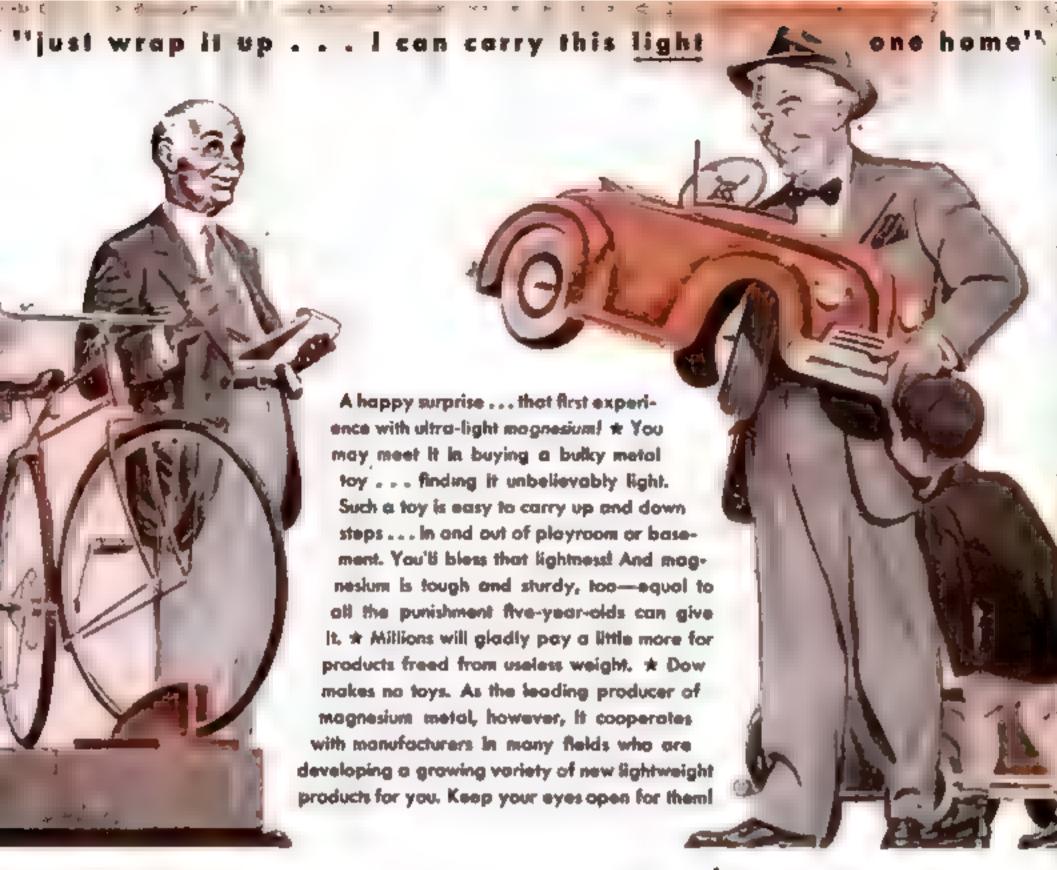
Another interesting device that can be hooked to the ranging set is the AP (attack plotter). It has a special circular scope, similar to one type of radar scope, which provides a running account of a whole battle that may be raging around a ship beneath the surface. It was particularly valuable against Nazi wolf packs and

Jap auiclde craft.

Sonar has even been combined with radar to produce robots called sono buoys. These were planted in harbors, channels, and other waters to watch for submarines. Each buoy consisted of a small, floating radar beacon with an underwater microphone. When the vibrations of a submarine's propeller were heard by this microphone, the radar transmitter was started. Each buoy was set so as to emit a distinctive signal. Planes and destroyers can move so much faster than a submarine that it often was possible to respond to these cries of alarm from sono buoys and drop depth charges before the submarine got away.

One time off Scotland, the sonar storytellers insist, a lighthouse equipped with underwater listening devices located a submerged U-boat and called up forces to surround it. Divers went down to tap on the side and tell the occupants in Morse code that they could either come up and surrender or be depth-bombed. The submarine crew tapped back that they'd come right

up—and did.



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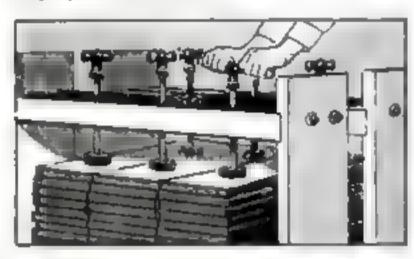
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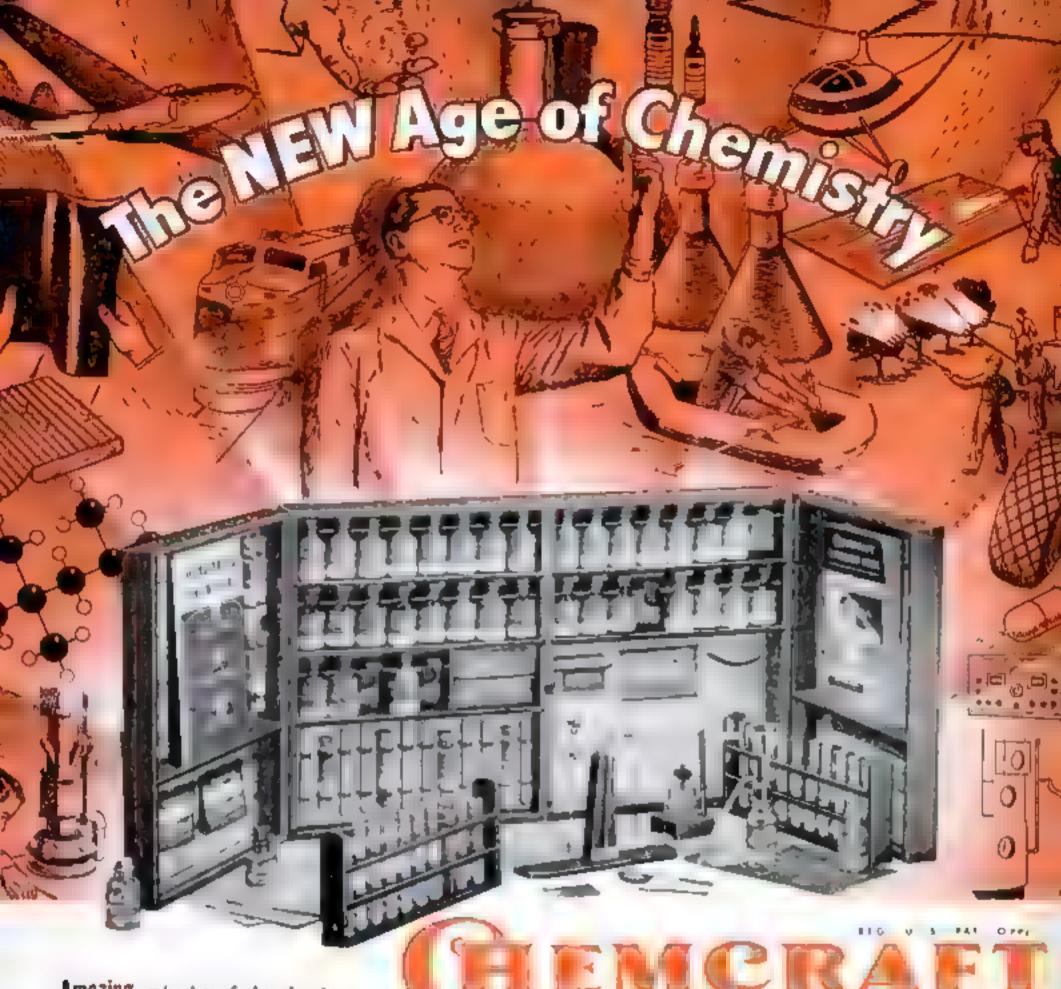
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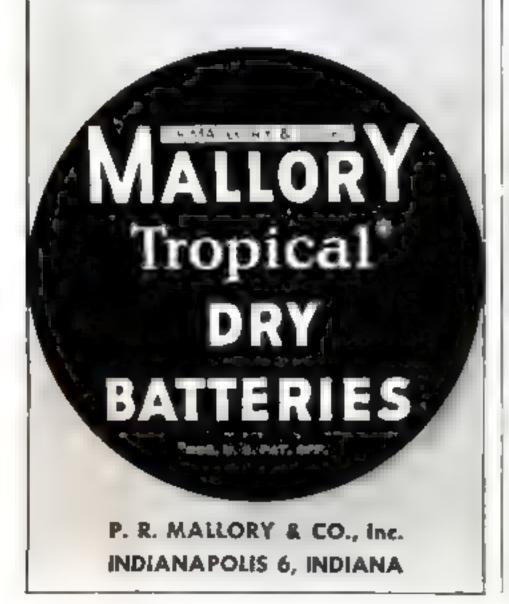
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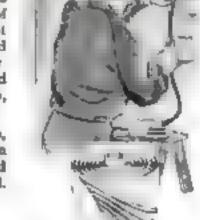


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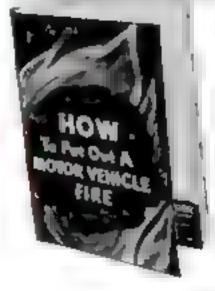
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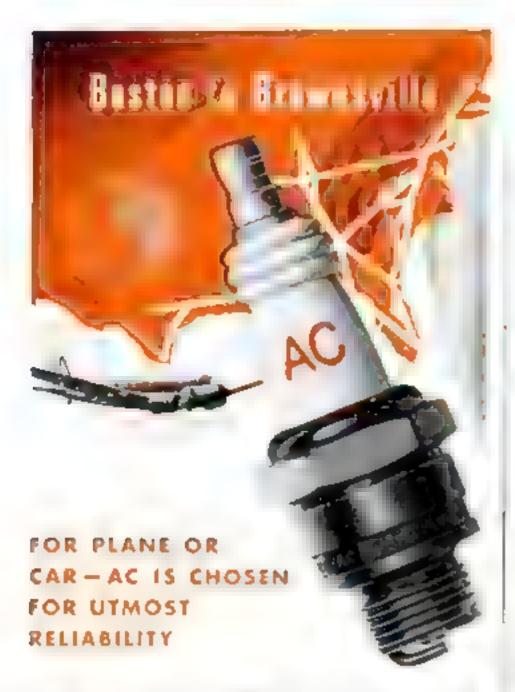
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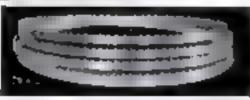
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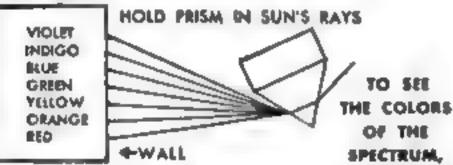
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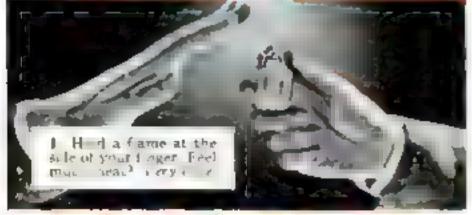
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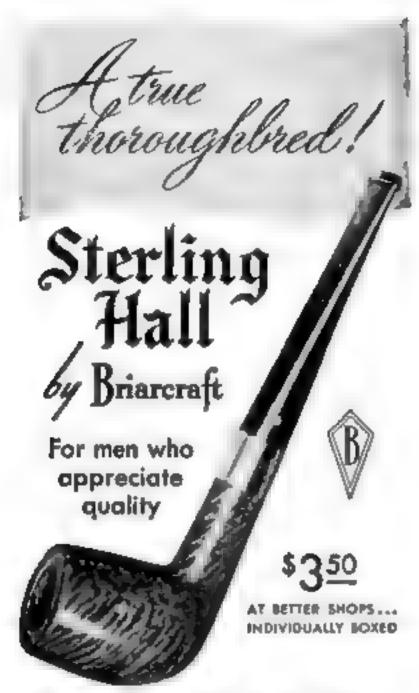




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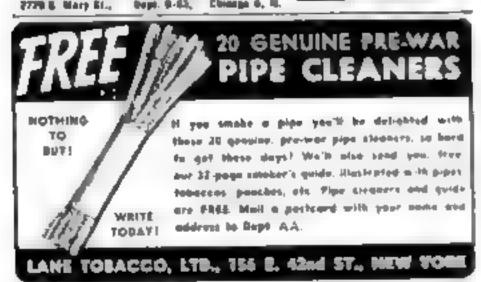
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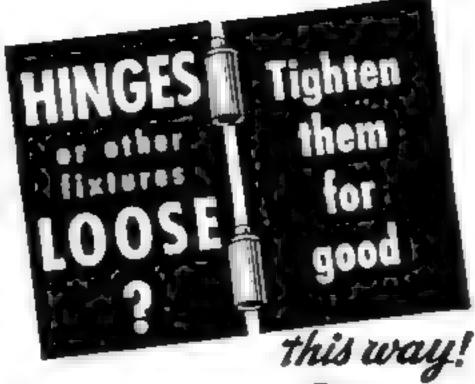
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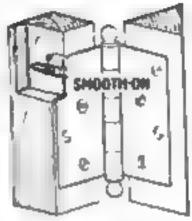
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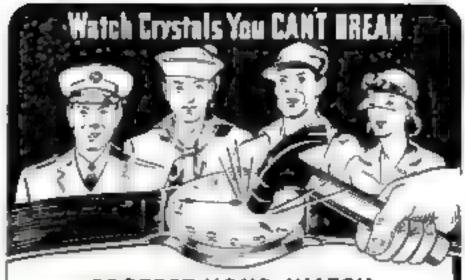
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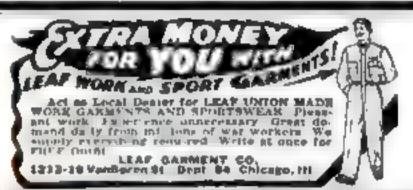
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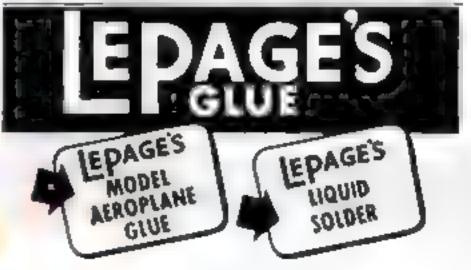
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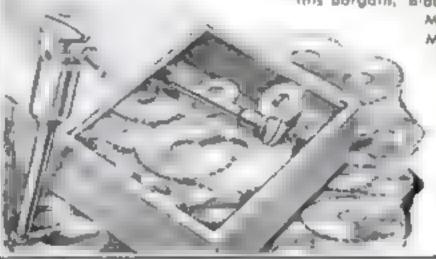
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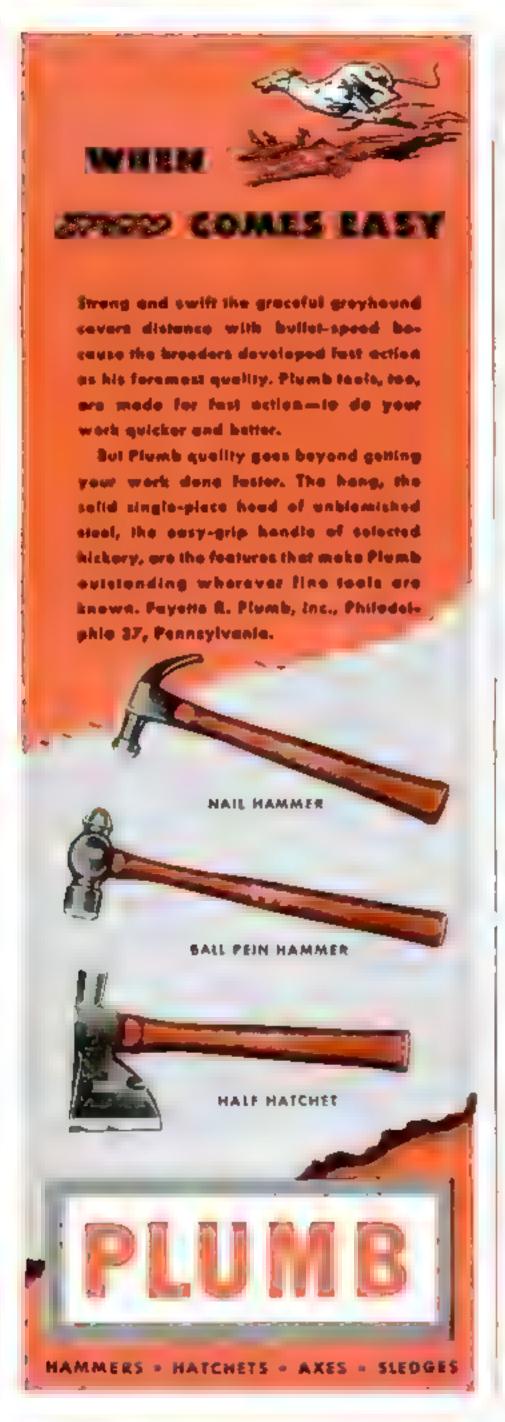
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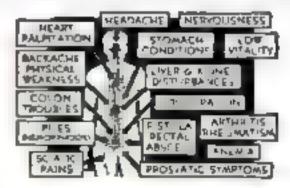


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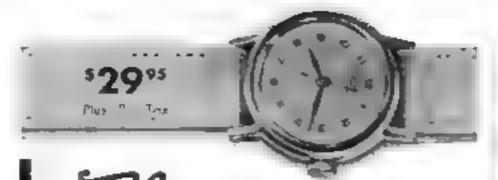
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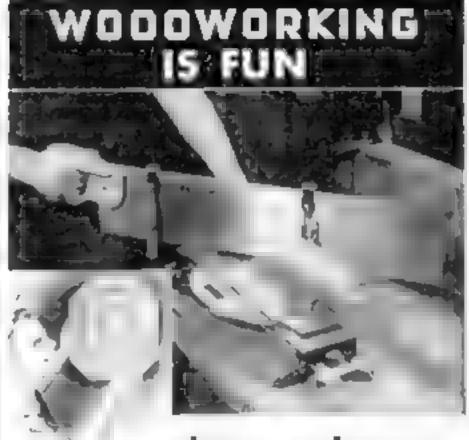


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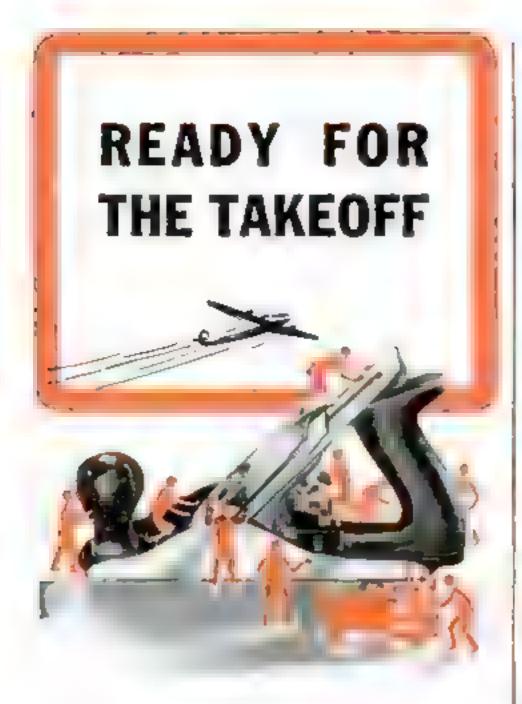
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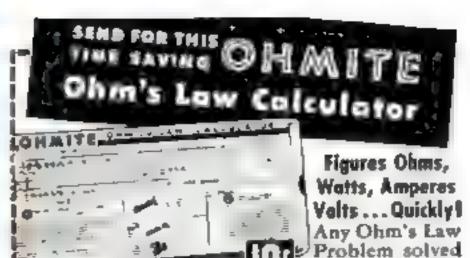


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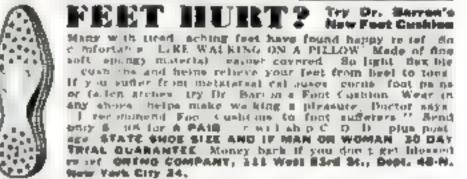
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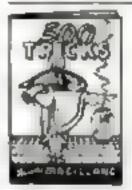
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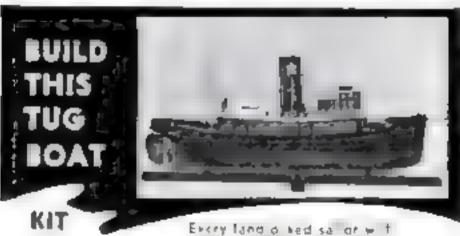
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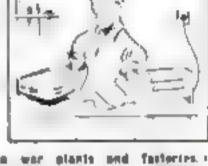
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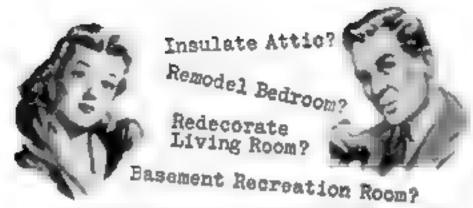


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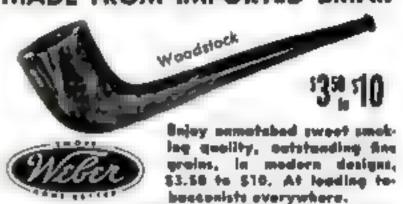
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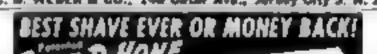
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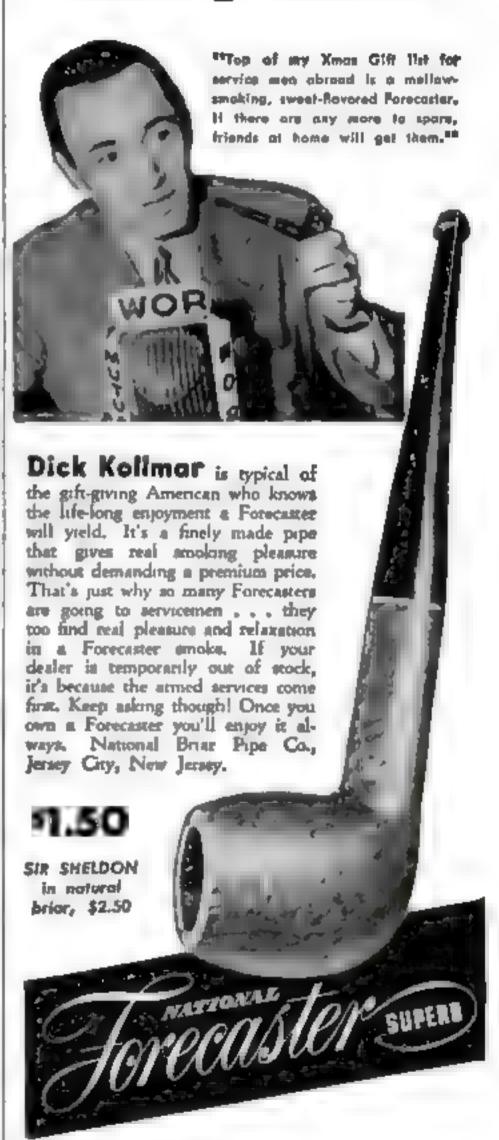
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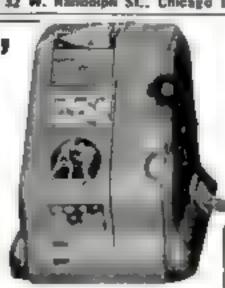
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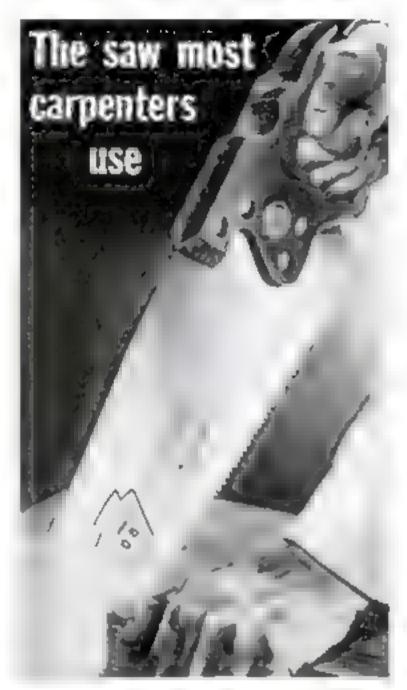


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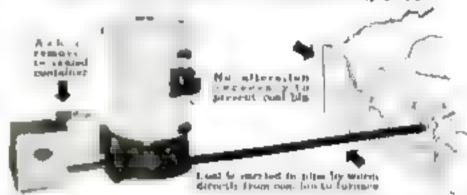
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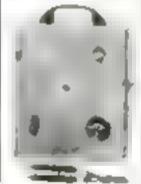
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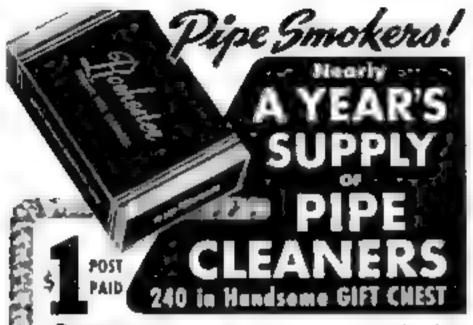
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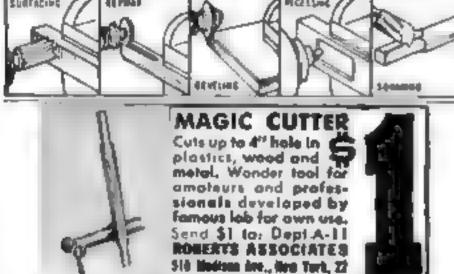
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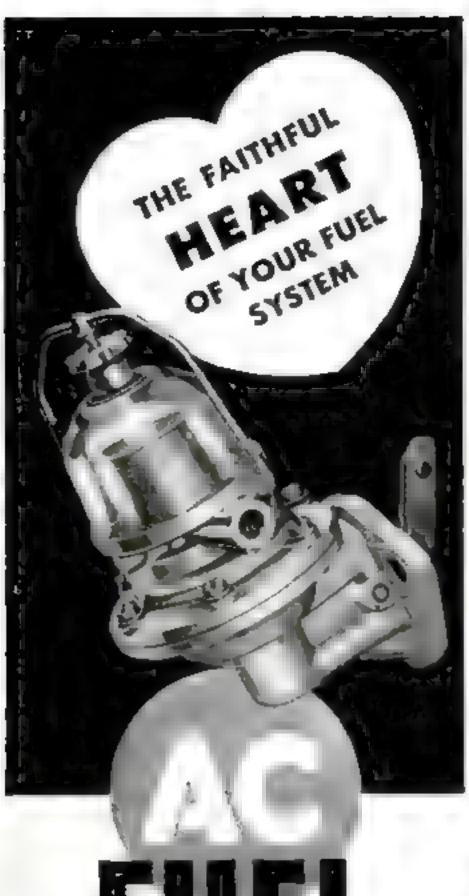
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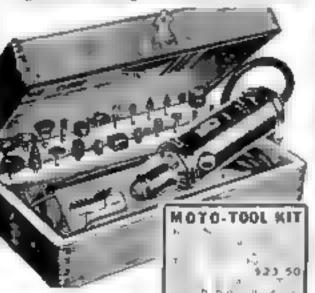


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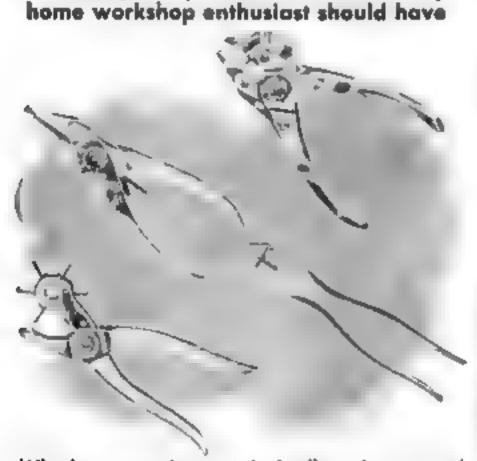
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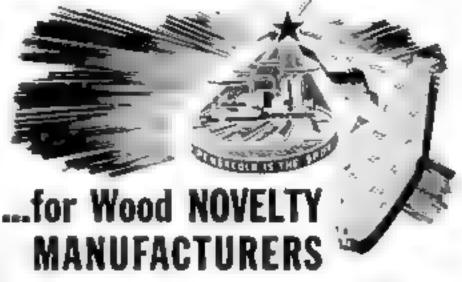
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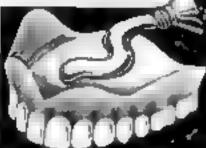
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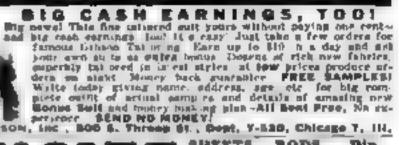
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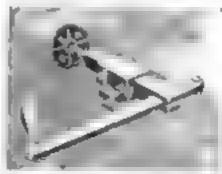
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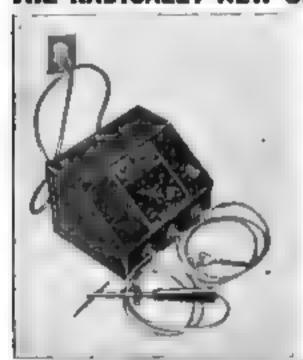
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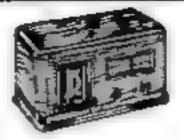


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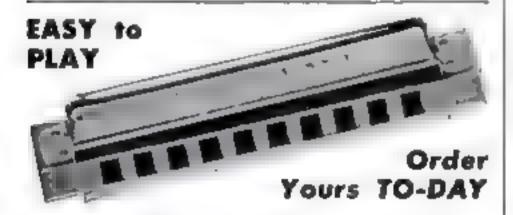
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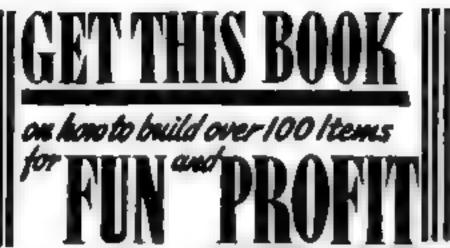


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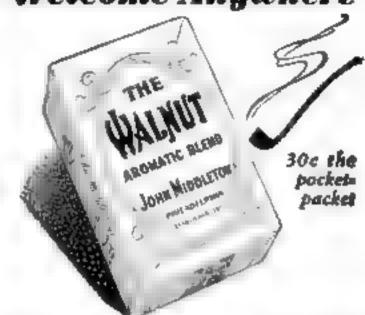
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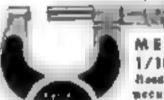


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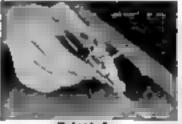
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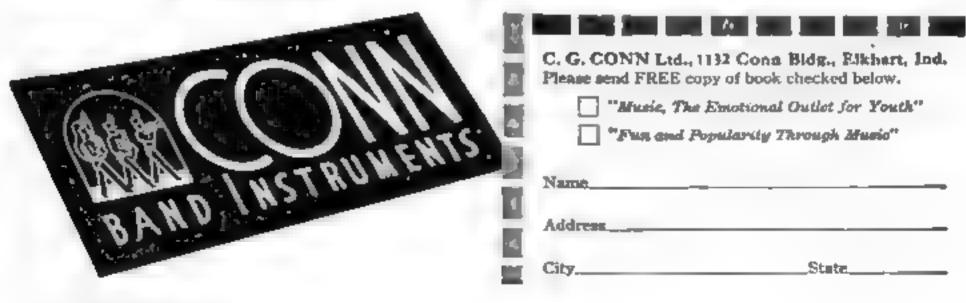
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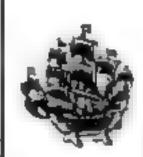
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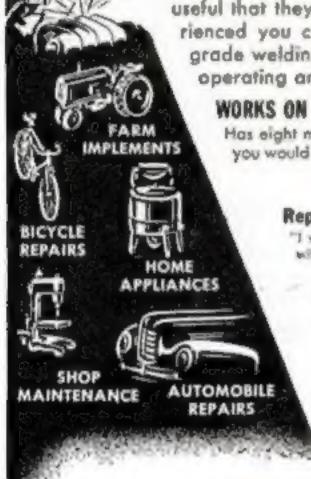
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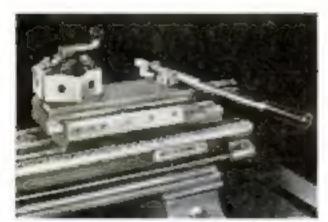
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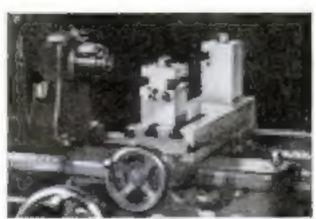
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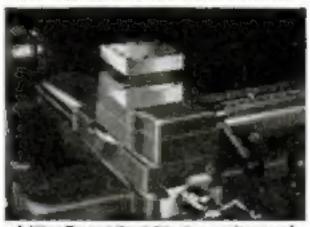
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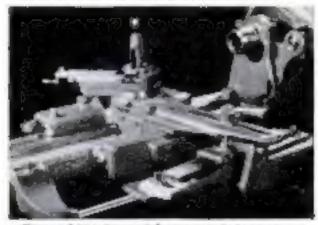
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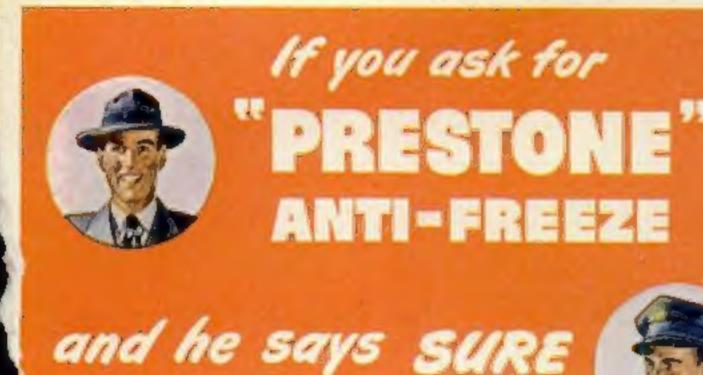
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